

### **III.3 STORAGE AND GROUNDWATER MANAGEMENT PROGRAMS: WITHIN THE REGION**

#### ***Planning Goals***

Groundwater basins within Metropolitan's service area are the foundation of the water supply system in Southern California, and conjunctive use is an important part of maintaining and enhancing the reliability of the basins. Conjunctive use refers to the use and storage of imported surface water supplies in groundwater basins and reservoirs during periods of supply abundance for use during times of need. Water years in California tend to be either wet or dry, with very few "average" years. Conjunctive use takes advantage of this by recharging basins during wet years and pumping during dry years. Basins are recharged with imported surface water supplies using spreading basins and injection wells, or by substituting imported water for pumping (in-lieu storage).

Local water management in Metropolitan's service area has included the conjunctive use of surface water and groundwater sources since the 1950's. Conjunctive use will be an even more important part of Metropolitan's water supply reliability as Metropolitan looks to the future. As populations grow and water demands increase, the ability to more effectively use existing supplies will enable Metropolitan to maintain its current high level of reliability. More than 70 recharge facilities in Southern California are currently being used to replenish the groundwater basins.

Many local groundwater storage programs have been implemented over the years to make maximum use of local water supplies. These programs have included the collection of local

runoff in surface storage reservoirs and the diversion of water flows into percolation ponds for artificially recharging groundwater basins. These measures can increase the overall yield of a groundwater basin, but the region must do more to take advantage of available water during wet years. Contractual conjunctive use programs will be an additional step toward more effective use of existing water supplies. Under a contractual storage arrangement with a groundwater basin, Metropolitan will store its available water supplies in a basin during wet years. During dry years, Metropolitan will notify the entities overlying the basin to either shut off completely or reduce the amount of imported surface water deliveries. The entities overlying the basin will then use facilities funded by Metropolitan to pump previously stored water to meet its demands. The surface water that Metropolitan would have delivered to the entities overlying the basin then becomes available for its other customers.

A number of significant developments both within the State and Metropolitan's service area will promote conjunctive use programs into the future. First, in March 2000, 65 percent of California voters approved Proposition 13, authorizing the state of California to sell \$1.97 billion in general obligation bonds for water-related projects throughout the State. The Governor's Annual Budget Revision document in May 2000 included \$763.3 million in expenditures from Proposition 13. In June 2000, the State Senate and Assembly approved a budget bill for fiscal year 2000-01, which earmarked \$45 million to fund conjunctive use programs within Metropolitan's service area. Metropolitan has sent out a Request for Proposals to its member agencies to submit conjunctive use programs for funding. Metropolitan hopes to build on the success of this initial funding to garner

additional monies from Proposition 13 to fund conjunctive use.

Second, after many years of developing conjunctive use programs, Metropolitan used its collective experience to develop a set of principles that would govern the development of conjunctive use programs into the future. In January 2000, Metropolitan's Board of Directors approved the Principle for Developing Groundwater Storage Programs. The Principles are as follows:

- **Regional Benefit** – Groundwater storage programs must provide regional benefits to increase dry-year supply (in accordance with the Board's Water Surplus and Drought Management Plan) and reduce capital costs associated with Metropolitan's distribution system. Benefits must outweigh the risks involved with developing the program.
- **Partnership** – Groundwater storage programs must have strong local support in order to be successful. Partnership might also involve coordination of funds from other sources (e.g., state/federal funds).
- **Address Local Needs** – When developing groundwater storage programs, Metropolitan must consider the individual needs of the groundwater basin and local communities. Programs should consider issues such as water quality, reliability of supply, financial benefits, and groundwater levels.
- **No Negative Water Supply or Water Quality Impact** – Groundwater storage programs should be designed so there are no negative water quality or supply reliability impacts to Metropolitan's member agencies.

- **Financial Integrity** – Programs should ensure the financial integrity of Metropolitan and its member agencies consistent with the Strategic Plan Policy Principles (Principles) which were approved by the Board on December 14, 1999. The Principles will be included in a new Strategic Plan to be adopted next year. Investments made by Metropolitan for storage will not be used by local agencies to reduce their demands for Metropolitan's imported supply in a manner that threatens Metropolitan's financial integrity. Participating member agencies would commit to the purchase of fixed amounts of imported water from Metropolitan.
- **Phased Approach** – Groundwater storage programs should be implemented in phases. At first, smaller-scale programs should be designed to meet overlying demand in lieu of Metropolitan's surface deliveries. As the programs are operated, levels of trust can be established and technical issues resolved. If successful, these programs can be expanded to the point where groundwater can be exported to other parts of the service area.
- **Shared Risk** – There are risks associated with developing any water resource program, including groundwater storage. Metropolitan should be willing to share the appropriate risk of implementing groundwater storage programs with local entities to the extent benefits outweigh the risks.

Metropolitan expects that these Principles will be a solid foundation for future development of conjunctive use programs.

Metropolitan has not been the only agency active in trying to develop conjunctive use within the southern California region. The Association of Ground Water Agencies (AGWA) also has been very active in promoting conjunctive use. In December of 1995, AGWA released the report "Defining Conjunctive Use Programs for Southern California's Groundwater Basins and Metropolitan's Imported Supplies." This report identifies approximately 1.5 million acre-feet of storage available for conjunctive use in southern California. The report outlines opportunities for storage of 100,000 acre-feet or greater in the Orange County, Raymond, San Fernando, Main San Gabriel, Central, West, North Las Posas and Chino basins. Metropolitan will need to form partnerships with these basins to develop conjunctive use programs. The information from AGWA's studies will be a valuable source of information for the IRP update.

### ***Existing Programs***

Over the years, Metropolitan has encouraged and implemented conjunctive use through various incentive programs. In addition, federal and other forms of funding have assisted in the recovery of existing groundwater in the region.

### **Basin Remediation**

A decade ago, water quality problems raised serious concerns about the ability to sustain the average annual production from the groundwater basins. Now the federal Superfund program is beginning to show significant progress toward maintaining and increasing groundwater basin production. Metropolitan and its member agencies have encouraged the recharge of groundwater basins and the recovery of degraded groundwater. These projects have increased production in all year types. To increase supplies in dry years,

Metropolitan has undertaken a number of local storage projects with its member agencies. Cleanups of Superfund sites have increased production in the San Fernando, Raymond, and Main San Gabriel basins. In other basins (West Coast, Central, and Orange) local groundwater treatment projects have increased groundwater production capacity by over 50,000 af per year during the past decade. In the Chino Basin, the Optimum Basin Management Program was approved in the summer of 2000, and desalter projects described in that program are now moving forward. Due to Metropolitan and member agency efforts, groundwater production is expected to increase over the next twenty years. Table III-12 identifies the expected locations and amounts of these increases.

**Table III-12**  
**Forecast Increases in Annual**  
**Groundwater Production by Basin**  
**(AF/YR)**

San Fernando <sup>1</sup>	40,000
Orange	60,000
Chino	50,000
West Coast	20,000
Central	25,000
Main San Gabriel	30,000
SDCWA <sup>2</sup>	37,000
Total	262,000

<sup>1</sup>Based on conversations with Mel Blevins, Watermaster for San Fernando.

<sup>2</sup>Increases in all basins in the SDCWA service area by 2020

The above estimates, except for SDCWA, have been reviewed and approved by the Association of Groundwater Agencies.

### **Local Storage Programs**

Metropolitan has developed a number of local programs to work with its member agencies to increase storage and assist in the efficient use of the groundwater basins. The following section describes the programs and their success to date in achieving IRP goals. Although the incentive structure associated with these programs may be modified as a result of the Strategic Planning Process and the

implementation of the new rate structure, it is expected that the regional benefits associated with these programs will be encouraged to continue.

#### *Seasonal Storage Service*

The Seasonal Storage Service (SSS) program has three major goals:

- Achieve greater water supply reliability through increased conjunctive use of imported and local water supplies
- Encourage the construction of additional local production facilities
- Reduce member agencies' dependence on deliveries from Metropolitan during summer months and times of shortage

There are several service categories in the SSS program. They vary both by the method of delivery and by the time-period for which the water is stored. These variations are:

- Direct deliveries to storage – Metropolitan delivers SSS water directly to water storage facilities, including local reservoirs owned and operated by member agencies, spreading sites for groundwater replenishment, and injection wells for groundwater replenishment.
- In-lieu deliveries to storage – SSS deliveries are made directly to the member agency's distribution system. The member agency then delivers this water rather than producing water from local sources. The deferred local production results in water remaining in local storage (surface or groundwater) for future use.
- Seasonal shift storage – Stored water is withdrawn (or deferred water production takes place) during the following summer.

As a result, the seasonal mix of supplies changes while Metropolitan's annual deliveries to the member agency (and the member agency's annual local production) remain unchanged by the agreement.

- Long-term storage – Deliveries under this category may be interrupted in the event of a shortage or other operational constraint. There are two types of long-term storage. In the first type, SSS water remains stored for longer than 12 months. Total annual deliveries of Metropolitan supplies increase under this concept. In the second type, deliveries are used to increase the operating yield of a groundwater basin. After an interruption, SSS water is taken to refill the overproduction in the basin.

Consistent with the goal of reducing water deliveries over the summer, seasonal shift storage water is only offered from October 1 through April 30. Long-term storage is available at the discretion of the General Manager, and is based upon balancing supplies and demands. Direct deliveries for long-term storage may be activated or terminated upon immediate notice. In-lieu deliveries may be activated upon immediate notice and terminated upon 15 days' notice.

To encourage member agencies to participate in this program, Metropolitan offers SSS water at reduced rates. To show the incentive provided by these rates, Table III-13 presents the SSS water rates contrasted with the rates for full-service supplies for 1997-98 to 2000-01.

#### *Cyclic Storage Agreements*

The Cyclic Storage Program was developed to increase Metropolitan's operational flexibility. It gives Metropolitan the ability to deliver replenishment water when it is available in wet periods and the ability to stop

**Table III-13**  
**Selected Metropolitan Water Rates, 1997-1998 to 2000-2001**  
(per af)

Rate category	July — December	January — June
<i>Full Service</i>		
Untreated full service	\$349	\$349
Treated full service	\$431	\$431
<i>Seasonal Storage Service</i>		
Untreated shift storage	\$266	\$277
Treated shift storage	\$323	\$334
Untreated long-term storage	\$233	\$233
Treated long-term storage	\$290	\$290

the delivery of replenishment water when supplies are restricted. The goal of the program is to avoid losing available water by increasing groundwater basin levels above what they would otherwise be.

The cyclic storage agreements instituted to date are shown in Table III-14. This program cannot be applied to all aquifers within Metropolitan's service area. The program only applies where groundwater basins have ongoing basin management programs that require replenishment water and where additional storage can allow for later withdrawals above safe yield.

This program provides some limited drought benefits to participating agencies. Water in cyclic storage increases the length of time over which normal groundwater replenishment supplies can be interrupted during a drought. Basin managers have stated that, without cyclic storage, replenishment deliveries to groundwater basins could be interrupted for three years. After that time, deliveries would have to resume to protect groundwater quality and to prevent severe overdraft.

Cyclic storage agreements extend this period of interruption to four or five years, depending on the size of the agreement. The drought benefit has no impact until the fourth year after replenishment deliveries have been suspended.

Where agreements are in place, Metropolitan may make deliveries to the basin over and above an agency's normal replenishment demand, providing an additional place for Metropolitan to store water. These additional deliveries are not billed to the member agency, but are credited to that agency's cyclic storage account. When conditions prevent Metropolitan from meeting physical replenishment deliveries, the water is debited from the cyclic storage account and credited to the replenishment account of the same agency. This strategy maintains the member agency's replenishment requirements at a time when replenishment deliveries would not otherwise be made. At this time, the agency is billed for the credited water, providing additional revenue to Metropolitan at a time when other revenue would likely be reduced by supply shortages.

**Table III-14**  
**Summary of Cyclic Storage Agreements**  
 (af)

Agency	Maximum Account Level	Current <sup>1</sup> Storage Level
Inland Empire Utilities Agency	n/a	36,000
MWD of Orange County	70,000	53,000
Three Valleys MWD	25,000	13,000
Upper San Gabriel Valley MWD	100,000	54,000
<b>Total</b>	<b>195,000</b>	<b>156,000</b>

<sup>1</sup> As of August 2000.

Metropolitan's operating objective is to store two years' worth of replenishment requirements within the basins. The goal is to balance the accounts over a short time-period, typically about three years, thus optimizing the operating flexibility objective of the accounts.

#### *Demonstration Local Storage Programs*

In 1993, Metropolitan instituted two demonstration storage programs in conjunction with the city of Anaheim and the Calleguas MWD. Water was placed in storage in 1993 and 1994. The water remains in storage until called for by Metropolitan's General Manager.

When the water is called for, agencies document that the stored water has been produced by comparing their operations to an agency-specific 1992 baseline, with adjustments to reflect demand growth and local supply changes. If the agencies are unable to produce this stored water on request, they incur a penalty rate equal to the full-service untreated water rate. This penalty would be added to whatever other water charges applied at the time of Metropolitan's request. For these demonstration projects, Metropolitan is only able to call for water until April 2003. After that time, the water reverts to the ownership of the storage operator. The goal of these programs is to demonstrate the feasibility of cooperative storage programs, rather than to

gain long-term water storage. As a result, the amount of water stored does not count toward the IRP goals for storage.

#### *Contractual Storage Program*

In the IRP, Metropolitan estimated that the Seasonal Storage Program encouraged the production of an additional 100,000 af of groundwater per year. The Preferred Resource Mix calls for an additional 200,000 af of dry-year production from groundwater storage by 2020. To achieve this goal, the IRP identified the need for additional dedicated storage in the local groundwater basins.

- *Calleguas MWD/Metropolitan Groundwater Storage Program:* In 1995, Metropolitan and the Calleguas Municipal Water District (Calleguas) signed a groundwater storage agreement. The agreement gives Metropolitan the right to store up to 210,000 af of water in the North Las Posas Groundwater Basin. Metropolitan will fund up to 30 aquifer storage and recovery wells in the basin. These wells will ultimately be able to pump 70,000 af of water from the basin.

When Metropolitan needs additional water supplies, it will notify Calleguas, which will reduce its deliveries of Metropolitan's

surface supplies. To meet its demand, Calleguas will pump Metropolitan's previously stored water from the groundwater basin. The surface water that would have been delivered to Calleguas will then be available for Metropolitan's other member agencies. Calleguas pays the firm water rate, and Metropolitan pays the pumping cost.

Calleguas has completed the construction of four wells and a connecting pipeline. An additional 14 wells and connecting pipeline are under construction. This agreement will terminate in 2035, unless otherwise agreed to by the participants.

- *Foothill MWD and City of Pasadena:* Metropolitan has executed an Interim Conjunctive Use Program with the Foothill Municipal Water District and the city of Pasadena. The Interim Conjunctive Use Programs with these two member agencies result from the phasing out of Metropolitan's Cooperative Storage Program. The water held on behalf of Metropolitan in the Raymond Basin by the Foothill Municipal Water District and the city of Pasadena was transferred into the Interim Conjunctive Use Program to be produced if needed or until a long term

dry-year yield program is established. Under the Interim Conjunctive Use Program, Foothill Municipal Water District and the city of Pasadena would produce the water from the account as needed and reduce deliveries of surface water.

Table III-15 details the maximum capacity and current storage levels under the local contractual storage programs. Metropolitan is currently negotiating with a number of other agencies for groundwater basin storage programs. Figure III-4 shows the current and projected in-basin storage necessary to meet the IRP goals. It also shows that most of the needed capacity is already contracted, but also that a lesser amount of capacity must still be procured.

#### *Salt Water Barriers*

These deliveries are not part of Metropolitan's storage programs. The barriers are built by injecting water into the basins at strategic locations, and they help protect aquifers in the West Coast, Central and Orange County basins. These deliveries are not managed to provide storage, but they must be continued except under the most severe shortage conditions.

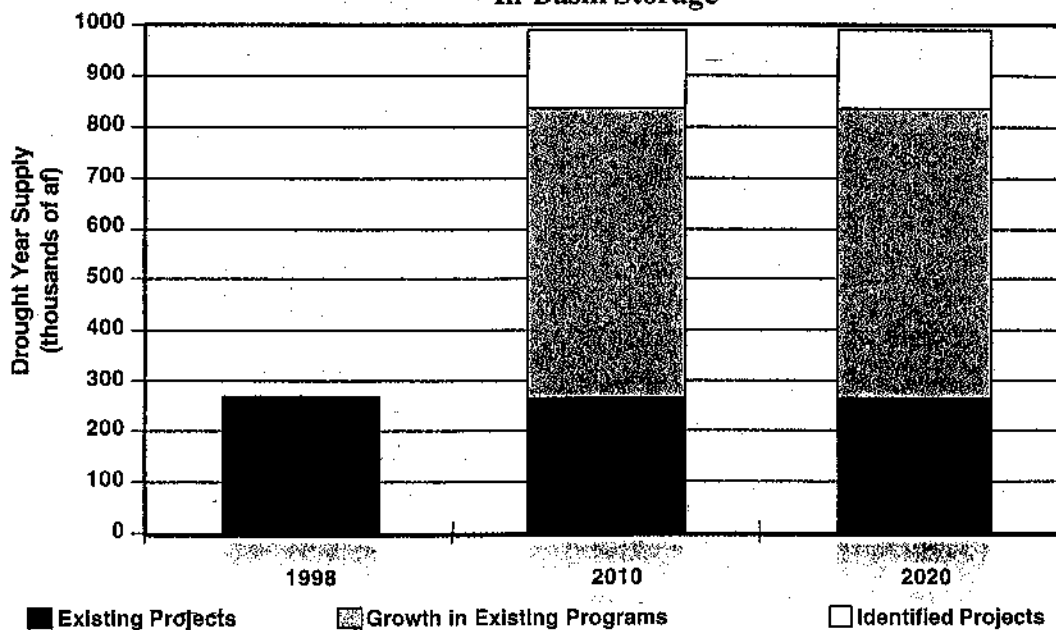
**Table III-15**  
**Summary of Contractual Storage Agreements**  
(af)

Agency	Maximum Account Level <sup>1</sup>	Current <sup>2</sup> Storage Level
Foothill Municipal Water District		1,991
City of Pasadena		21,967
Calleguas MWD	210,000	34,342
<b>Total</b>	<b>210,000</b>	<b>58,300</b>

<sup>1</sup> The Foothill and Pasadena agreements do not specify maximum account levels.

<sup>2</sup> As of August 2000.

**Figure III-4  
In-Basin Storage**



### **Surface Storage**

Since the beginning of the IRP process, two significant changes have occurred regarding regional surface storage:

#### **Diamond Valley Lake**

In early 2000, Metropolitan began filling its newly completed Diamond Valley Lake (formerly known as the Eastside Reservoir Project). Diamond Valley Lake is an 800,000 af reservoir that nearly doubles Southern California's total surface storage capacity. Half of the capacity of Diamond Valley Lake is reserved for use in emergencies (see Section II.2 – Planning for Catastrophe). The other half of the capacity is intended for carryover and regulatory storage operations. By the end of 2000, Metropolitan will have delivered slightly over 400,000 af into the reservoir. Assuming normal to wet hydrologic conditions and reasonable water quality in 2001, Diamond Valley Lake should be full by the end of 2001. Original estimates

for the time of initial fill ranged from two to five years.

A fully operational Diamond Valley Lake will significantly improve Metropolitan's water management operations. In addition to providing important carryover and emergency storage benefits for Southern California, Diamond Valley Lake will provide a vast improvement in the region's ability to regulate imported supplies and maximize the effectiveness of the groundwater basins. In the past, imported water intended for storage in groundwater basins was generally available in the winter months, when the region's spreading and percolation facilities were already full with natural runoff. With Diamond Valley Lake, large quantities of imported water can be stored until those facilities are available. The IRP identified the joint operations of Diamond Valley Lake and the groundwater basins as a strategy that would greatly leverage the benefits of both types of storage.



### SWP Terminal Reservoirs

Under the 1994 Monterey Agreement, Metropolitan was given operational control of 218,940 af in the reservoirs at the southern terminals of the California Aqueduct. This control gives Metropolitan greater flexibility in handling supply shortages.

### ***Achievements to Date***

Table III-16 summarizes the local groundwater storage identified and contracted for under the local storage programs. This table shows that

Metropolitan has identified about 400,000 af of local groundwater storage. With the completion of the Diamond Valley Lake, Metropolitan will have achieved its surface storage goals for the 2020 time frame. In the five years since the IRP was adopted, Metropolitan is approaching the half-way mark in achieving its 2020 goals for local storage.

**Table III-16**  
**Summary of Local Storage Programs**  
(af)

<b>Program</b>	<b>Capacity</b>
Cyclic Storage	195,000
Contractual Storage	210,000
<b>Total</b>	<b>405,000</b>



### **III.4 WATER SUPPLY MANAGEMENT PROGRAMS: SWP STORAGE OUTSIDE THE REGION**

#### ***Planning Goals***

The SWP delivers water to Southern California through the California Aqueduct, and is a major source of water for Metropolitan's service area. The potential deliveries from this source have decreased over time because of increased SWP demands by other contracting agencies and because of environmental stresses in the source watersheds. A major goal of the IRP is to develop additional reliability of supply through the California Aqueduct by purchasing out-of-region storage for SWP water and SWP water transfers for Metropolitan. In total, the IRP called for developing a total of 340,000 acre-feet (af) of dry-year storage and water transfer deliveries by 2000 and a total of 460,000 af by 2020.

#### ***Programs to Meet Goals***

This section describes the two water banking programs that Metropolitan has partnered in to help meet the IRP goal of developing additional reliability of supply through the California Aqueduct.

##### Semitropic Water Storage District

This agreement is between Metropolitan, the Semitropic Water Storage District (Semitropic) and its member agencies: the Semitropic Improvement District, Button-willow Improvement District, and Pond-Poso Improvement District. Semitropic obtains water from the SWP through its contracts with the Kern County Water Agency. An area of 136,370 acres within Semitropic's service

territory is irrigated by water obtained from the SWP. An additional 24,500 acres receives SWP water from Semitropic on an as-available basis. When this surface water is not available, farmers withdraw water from an underlying aquifer.

The contract between Semitropic and Metropolitan extends current operations to allow Metropolitan (and other banking partners) to make use of the additional storage in Semitropic's groundwater basin. In years of plentiful supply, Metropolitan will deliver SWP supplies to Semitropic through the California Aqueduct. This water will be conveyed to Semitropic farmers through a pre-existing distribution system, plus improvements to that system financed by the initial payments from Metropolitan. Because the farmers would otherwise have used water from the underlying groundwater basin, in-lieu use becomes the mechanism for storing water within the aquifer.

During dry years, Metropolitan will be able to withdraw the stored water. Semitropic built a 78-inch pumpback pipe that is capable of delivering 90,000 af per year directly to the California Aqueduct. In addition, Semitropic agreed to divert any of its SWP entitlement in excess of 25,000 af per year to meet withdrawals of stored water.

The program has a defined total storage capacity of 1 million af. Metropolitan's initial contract is for up to 350,000 af of storage capacity. Semitropic has sold the remaining 650,000 af to other water districts: Santa Clara Valley Water District, Alameda County Water District, Zone 7 Water District, and Vidler Water Company (a private water company located near La Jolla).

Annual withdrawal amounts are restricted by the size of the pumpback facility (90,000 af), contemporaneous scheduled SWP deliveries to Semitropic (above the reserved 25,000 af), and the proportion of the total program capacity that has been contracted to other banking partners. If all of the capacity has been contracted, and the SWP is scheduling 25,000 af or less to Semitropic, Metropolitan would be able to recover the minimum level of 31,500 af per year (which is derived by dividing Metropolitan's contracted storage capacity of 350,000 af by total program capacity of 1 million af multiplied by the pumpback capacity of 90,000 af). If additional water is available from the SWP, Metropolitan could achieve a maximum withdrawal of 170,000 af per year.

The agreement extends from December 1994 through November 4, 2035. The charges under this contract (in 1994 dollars) are as follows:

Initial payment schedule (before full vesting)

To store: \$90 per af

An additional \$20 per af is charged for water left in long-term storage (more than 5 years)

To recover: \$40 per af

When payments made by Metropolitan equal its proportion of the total capital costs of the program (full vesting), these rates decrease to the following levels.

Subsequent payment schedule

To store: \$50 per af, with no long-term storage charge

To recover: \$50 per af

All of these rates are adjusted annually by the western cities consumer price index.

In addition to these charges, Metropolitan must pay power costs, calculated by multiplying the amount of energy used to operate the program in any month by Semitropic's average unit power costs in the same month.

Semitropic has recently proposed construction of an additional pumpback facility that would provide an additional 200,000 af per year of capacity. The construction of this facility depends on the agreement of the participating agencies to pay for a share of the facility.

Arvin Edison Water Management Program

The Arvin-Edison Water Storage District (Arvin-Edison) manages the delivery of local groundwater and of water imported into its service area from the Central Valley Project's (CVP) Millerton Reservoir via the Friant-Kern Canal. The surface water service area consists of 132,000 acres of predominantly agricultural land, and to a minor degree, municipal and industrial uses. It is situated in Kern County. Arvin-Edison operates its supplies conjunctively, storing water in the underlying aquifer when imported supplies are plentiful and withdrawing that water when the availability of imported supplies are reduced. In the 1970s, Arvin-Edison entered into a number of agreements, jointly known as the Cross Valley Canal Exchange. This allows Arvin-Edison to schedule water deliveries through the California Aqueduct.

The contract between Arvin-Edison and Metropolitan extends the current operations to allow Metropolitan to make use of the additional storage capacity in Arvin-Edison's groundwater basin. In years of plentiful supply, Metropolitan can deliver SWP supplies to Arvin-Edison through the California Aqueduct. Some of this water is stored in the aquifer through spreading basins, and the remainder is delivered directly to Arvin-

Edison farmers. The farmers would otherwise have used water from the groundwater basin, so this in-lieu use is another mechanism for storing water within the aquifer. During dry years, a portion of Arvin-Edison's CVP entitlements can be diverted for delivery to Metropolitan through the California Aqueduct.

The agreement extends from December 1997 through December 2022. While the initial goal is to make more efficient use of SWP supplies, water available from other sources may also be stored in the aquifer. Metropolitan's initial contract is for up to 250,000 af of regulated water, but the contract contains an option for the maximum storage to be increased to 385,000 af of regulated water. For operational reasons, withdrawal amounts are restricted to 40,000 to 75,000 af per year.

To facilitate the additional storage within Arvin-Edison's aquifer, Arvin Edison is extending its distribution system. To finance this expenditure, Metropolitan paid an up-front fee to Arvin-Edison. The additional charges (expressed in 1996 dollars) for operation of this program are as follows:

**(1) First 250,000 af (Regulated Water)**

To store: \$90 per af (less \$35 per af credit for the advance payment)

To recover: \$40 per af (less \$9.11 per af credit in recognition of Metropolitan's advance payment of \$12,000,000)

**(2) Beyond 250,000 af (Regulated Water)**

To store: \$70 per af

To recover: \$30 per af

In addition to these charges, Metropolitan must pay the average unit power and energy costs for operating the program, plus pre-determined operation, maintenance and replacement fees. This requirement is pursuant to the "Agreement between Arvin-Edison Water Storage District and the Metropolitan Water District of Southern California for a Water Management Program," dated December 19, 1997.

**Achievements to Date**

The total capacity and current storage situation for these two programs to store SWP water are summarized in the Table III-17.

During 2000, Metropolitan plans to deliver an additional 120,000 af of Regulated Water for a year-end storage goal of about 662,700 af. This shows that Metropolitan has not yet achieved its year 2000 goal of 340,000 af per year of dry-year supplies, but is progressing towards its year 2020 goal of 460,000 af.

**Table III-17**  
**Metropolitan's Out-of-Region Storage**  
**For SWP Water**  
(af)

Agreement	Storage Capacity	Current Storage Level	Contractual Annual Deliveries	
			Minimum	Maximum
Semitropic	392,192	392,192 <sup>1</sup>	31,000	170,000
Arvin-Edison	385,000	231,561 <sup>2</sup>	40,000	75,000
<b>Total</b>	<b>777,192</b>	<b>623,753</b>	<b>71,000</b>	<b>245,000</b>

<sup>1</sup> As of December 2000

<sup>2</sup> As of September 2000.



### **III.5 MANAGEMENT OF COLORADO RIVER SUPPLIES**

#### ***Planning Goals***

Water from the Colorado River is delivered to Metropolitan's service area via the Colorado River Aqueduct (CRA). Metropolitan's policy is to maintain a full CRA at the lowest possible cost to member agencies. The cost of water obtained through the aqueduct will vary, however, as a result of market, legal, and policy factors.

#### ***Rights to Colorado River Water***

Under a normal condition, California has a basic apportionment of 4.4 million acre-feet (af) per year. The Secretary of the Interior (Secretary) may also make available for use within a Lower Division State (Arizona, California and Nevada) any water that was apportioned to but unused by another Lower Division State. In addition, surplus water, which is defined as water in excess of the 7.5 million af of the normal Lower Division State's apportionments, could be made available to the three states collectively. California is entitled to 50 percent of this surplus water. Metropolitan has a specific contract to 180,000 af of surplus water when it is available.

Metropolitan's water delivery contracts are with the U.S. Department of the Interior, and they incorporate provisions of the 1931 Seven-Party Agreement. Under this agreement, the Palo Verde Irrigation District (PVID), the Yuma Project (Reservation Division), Imperial Irrigation District (IID), and Coachella Valley Water District (CVWD) have the first three priorities to use no more than 3.85 million af per year. Metropolitan was allotted 550,000 af

per year under a fourth priority right and 662,000 af per year under a fifth priority right. These priorities are further discussed in Appendix A.2.

Currently, there is no further division of the rights of the holders of the first three priorities to use no more than 3.85 million af per year under the priority provisions of the Seven-Party Agreement. This lack of further quantification, other than by priority, makes developing and implementing cooperative water supply programs difficult, and it casts uncertainty on water supply reliability.

#### ***Reduced Availability of Colorado River Supplies***

Over the years, a number of factors have reduced the reliability of Colorado River water available to California. These are discussed in more detail in Appendix A.2 to this report, but are summarized below:

- The 1964 U.S. Supreme Court Decree in *Arizona v. California* reduced Metropolitan's dependable supply of Colorado River water to 550,000 af per year. The reduction in dependable supply occurred with the commencement of Colorado River water deliveries to the Central Arizona Project in 1985.
- In 1979, present perfected rights (PPRs) to the use of Colorado River water by certain Indian reservations and other users in California were recognized and quantified. Since 1985, these PPR holders have used less than 20,000 af annually. Because normal flows on the Colorado River were already allocated, it has not been clear which agency's supplies would be reduced in order to allow for these PPRs to be satisfied. However, the proposed

Quantification Settlement Agreement (Page III-53) would require that the responsibility for satisfying the demands of miscellaneous and Indian PPRs be divided among IID, CVWD, and Metropolitan, thus reducing Colorado River supplies to these agencies.

- As a result of increased diversions by both Arizona and Nevada, Metropolitan's total diversions could decline to its fourth priority right of 550,000 af per year plus any apportioned water left unused by other California contractors with a higher priority than Metropolitan in the amount of water conserved by IID for Metropolitan under the 1988 and 1989 agreements. Between 1986 and 1999, the amount of unused agricultural water available to Metropolitan has varied from zero to more than 500,000 af per year. That variability will continue in the future, depending on agricultural economics, type of crops grown, acreage irrigated, and water-use efficiency.

In addition, the Secretary could allow Metropolitan to divert surplus water and water that is unused by Arizona and Nevada. In years in which a surplus is available, Metropolitan would have the highest priority of any California contractor to that water by virtue of its fifth priority right. However, there are currently no formal guidelines to determine when such surpluses would be available.

### ***Programs to Meet Goals***

To increase supplies, Metropolitan has executed a number of agreements with agencies that have Colorado River entitlements or who are in proximity to the CRA. Figure III-5 identifies four of the programs designed to maximize the availability of Colorado River supplies to Metropolitan.

### **Groundwater Storage Program in Upper Coachella Valley**

The Desert Water Agency (DWA) and CVWD, both in Riverside County, have entitlements to State Water Project (SWP) water, but they don't have any physical connection to SWP facilities. Both agencies, however, are adjacent to the CRA. To enable them to obtain water equal to their SWP entitlement, Metropolitan has agreed to exchange an equal quantity of its Colorado River water for DWA and CVWD's SWP water. DWA has a SWP entitlement of 38,100 af per year, and CVWD has a SWP entitlement of 23,100 af per year, for a total of 61,200 af per year.

In addition, DWA and CVWD have historically contracted for Pool B water from the SWP, and Metropolitan has agreed to a similar method of exchange for deliveries of Pool B water.<sup>1</sup> These exchanges provide water to Metropolitan with a lower concentration of total dissolved solids than it would otherwise receive, and they allow DWA and CVWD to obtain imported water supplies they could not otherwise access.

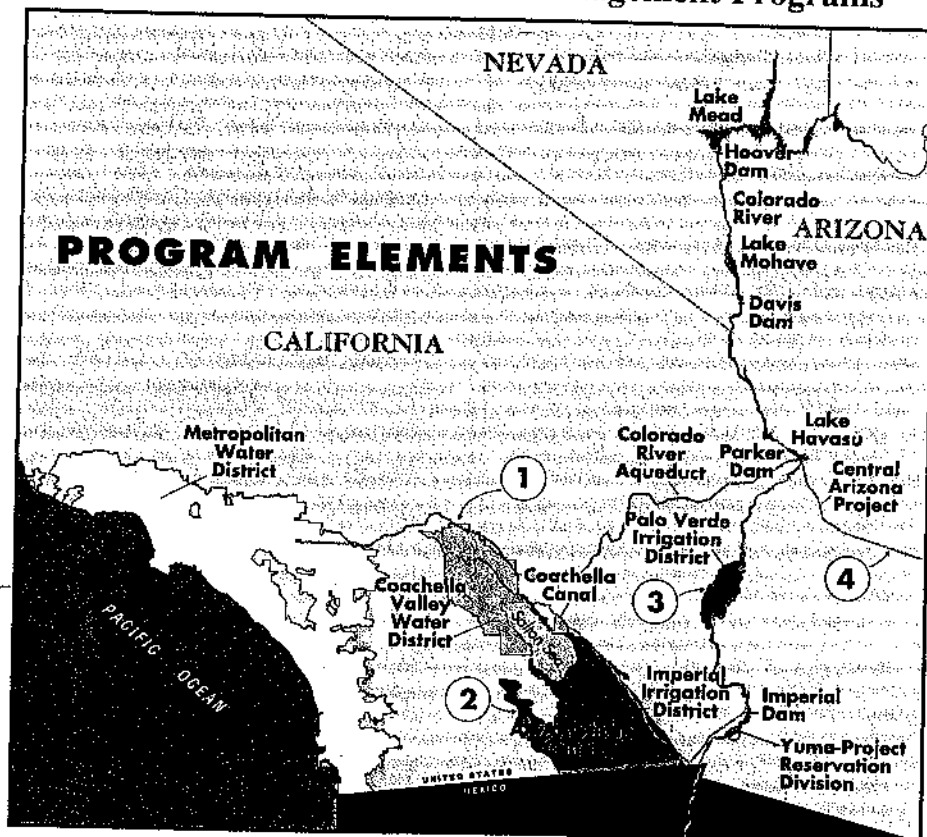
The original exchange contracts were to be in effect from 1967 through January 1, 1990. In 1983, however, they were extended through 2035.

In 1984, Metropolitan executed an Advance Delivery Agreement with these two agencies. It allows Metropolitan to supply DWA and CVWD with Colorado River water in advance of the time they are entitled to receive water under the exchange contracts. In future years, Metropolitan can recover this water by reducing its deliveries under the exchange contracts.

<sup>1</sup> Pool B water is a program administered by DWR to allow a participating State Water Project contractor to sell allocated but unused entitlement water to another participating State Water Project contractor.



**Figure III-5**  
**Colorado River Resources Management Programs**



**Key**

1. Groundwater Storage Program in the Upper Coachella Valley,
2. Water Conservation Program in the Imperial Valley,
3. Test Land Fallowing Program in the Palo Verde Valley,
4. Demonstration Groundwater Storage Program in Central Arizona.

As of November 2000, 261,600 af are available under this agreement. The maximum amount that can be stored under this agreement is 600,000 af, and the maximum annual withdrawal is currently 61,200 af plus the amount of SWP Pool B water available.

Water Conservation Program in the Imperial Valley

IID uses the largest amount of California's apportionment of Colorado River water. Under a 1988 agreement, Metropolitan has funded water efficiency improvements within IID's service area in return for the right to divert the

water conserved by those investments for a period of time. The program implemented structural and non-structural measures, including the lining of existing canals with concrete, constructing local reservoirs and spill-interceptor canals, installing non-leak gates, and automating the distribution system. Other implemented programs include the delivery of water to farmers on a 12-hour rather than a 24-hour basis and improvements in on-farm water management through the installation of tailwater pumpback systems, drip irrigation systems, and linear-move irrigation systems. With program implementation

completed in 1998, Metropolitan has an additional 109,460 af per year of Colorado River water available in 2000. This water may be diverted each year, or it may be stored in a reservoir for future use pursuant to a valid banking agreement. The initial term of the agreement is 44 years, from 1990 to 2033.

The proposed Quantification Settlement Agreement (Page III-53) will change this program to a degree. The proposed settlement contemplates that approximately 90,000 af per year of water obtained through this program would continue to be available to Metropolitan for an extended term of up to approximately 75 years. The remainder of the conserved water from this program (20,000 af per year) would be available to CVWD.

#### Test Land Fallowing Program in the Palo Verde Valley

Land fallowing is an option that provides a way to obtain needed water supplies during dry years. From 1992 to 1994, Metropolitan conducted a test program involving 63 landowners and lessees in the Palo Verde Valley. Metropolitan paid the lessees (or landowners if the land was not leased), to fallow 20,215 acres of farmland within PVID. The program saved 185,978 af over a two-year period. This amount was stored in Lake Mead for use by Metropolitan by the year 2000. This test land fallowing program investigated the mechanisms required to implement this type of option and provided Metropolitan with the ability to use the saved water if it were needed. In 1997, however, Lake Mead filled to a level that required the water to be released for flood control purposes.

#### Demonstration Groundwater Storage Program in Central Arizona

In 1992, Metropolitan entered into an agreement with the Central Arizona Water Conservation District (CAWCD) that allowed unused Colorado River water to be stored in central Arizona aquifers, thus reducing the potential for future flood control releases from Lake Mead. The Southern Nevada Water Authority also participates in the program.

When Metropolitan wishes to recover the stored water, CAWCD will reduce its Central Arizona Project (CAP) diversions, and the Secretary will allocate the unused CAP apportionment to Metropolitan. This mechanism can be exercised in a year when Arizona's Colorado River supply is at least 2.8 million af. The maximum amount recoverable is 15,000 af per month. When Metropolitan recovers any of the water stored under this program, Metropolitan's water balance will be debited by 110 percent of the water recovered. This factor is applied to conform to Arizona state law, which requires that a portion of any stored water be left underground.

A maximum of 300,000 af may be stored under this program through December 31, 2000. As of October 2000, Metropolitan had stored 89,000 af. Metropolitan paid the cost of transporting the water through the CAP; CAWCD is responsible for the recovery costs.

## Potential Programs

### The California Plan

For a number of years, Metropolitan has been engaged in discussions with other California entities, federal representatives, and entities representing the other Colorado River Basin states regarding California's use of Colorado River water. The Secretary and the Bureau of Reclamation (Reclamation) are considering guidelines to determine under what conditions surplus water would be made available to California. Although the Secretary made surplus water available from 1996 through 2000, adoption of guidelines would provide greater predictability of the availability of these supplies for Metropolitan. The guidelines would be used under the authority of the Boulder Canyon Project Act, the 1964 U.S. Supreme Court Decree in Arizona v California, and the Criteria for the Coordinated Long-Range Operation of the Colorado River Reservoirs in the development of the Annual Operating Plan for the Colorado River System Reservoirs.

In 1996, the Arizona Legislature created the Arizona Water Banking Authority to protect Arizona's supply of Colorado River water and to provide opportunities for interstate banking by California and Nevada. By diverting otherwise unused water and storing it underground, Arizona has reduced California's use of water from this source.

In December 1996, the other six Colorado River Basin states expressed in writing their concern that California agencies appeared to be assuming that the Secretary would continue to approve the use of surplus water for the foreseeable future. They requested that California develop a plan to reduce its dependence on Colorado River water over its normal apportionment in a way that avoids undue risk of shortage to the other basin states.

In that same year, the Secretary deferred further consideration of any Colorado River interim surplus guidelines until California put in place a realistic strategy to ensure that it will either be able to 1) limit its annual use of Colorado River water to 4.4 million af when necessary or 2) meet its needs from sources that do not jeopardize the entitlements of others. The Secretary considered the clarification of agricultural water rights subject to the Seven-Party Agreement to be a prerequisite for the approval of any new cooperative Colorado River water transfers between California agencies.

In response to these concerns, the Colorado River Board of California developed "California's Colorado River Water Use Plan" (Plan). The Colorado River Board of California protects California's rights and interests in the resources provided by the Colorado River and represents California in interstate discussions and negotiations regarding the Colorado River and its management. The overall purpose of the Plan is to provide California's Colorado River water users with a framework by which programs, projects, and other activities will be coordinated and implemented cooperatively. This cooperation will allow California to satisfy its annual water supply needs within its annual apportionment of Colorado River water in the most effective manner possible. The framework specifies how California will transition and live within its basic apportionment of Colorado River water when necessary. It is aimed at reducing California's reliance on Colorado River water.

The Plan framework encompasses and relies on:

- Further quantification of California's rights and uses of Colorado River water, where helpful, to facilitate the optimum use of California's Colorado River resources.
- Cooperative core water supply programs and voluntary transfers.
- Increased efficiencies in water conveyance and use.
- Water storage and conjunctive use programs to increase normal and dry-year water supplies.
- Water exchanges.
- Administrative actions necessary for effective use and management of water supplies.
- Improved reservoir management and operations.
- Drought and surplus water management plans.
- Coordinated project operations for increased water supply yield.
- Groundwater management.
- Colorado River salinity control and watershed protection.

Other key associated resource management concepts that the agencies are pursuing include:

- Lower Colorado River Multi-Species Conservation Program
- Water demand management (seasonal shift in deliveries, water scheduling changes, peaking modification, etc.)

- Additional water conservation
- Groundwater and surface water recovery
- Interstate offstream water banking
- Additional local projects
- Water reuse
- Other voluntary water transfers and water purchases

The California Plan includes the following programs:

- Conservation in the Imperial Valley
- A water transfer between the IID and the San Diego County Water Authority (SDCWA), and a water exchange between Metropolitan and SDCWA
- Recovery of seepage from portions of the All American and Coachella canals
- Storage of water in groundwater basins along the CRA, in the Coachella Valley and possibly in Arizona
- Periodic arrangements to fallow land

It also addresses the manner in which 16,000 af of water will be made available annually for the San Luis Rey Indian Water Rights Settlement.

Imperial Irrigation District-San Diego County Water Authority Transfer and Metropolitan-San Diego County Water Authority Exchange

In April 1998, IID and SDCWA executed an agreement to transfer between 130,000 and 200,000 af per year from IID for use in the SDCWA service area for an initial term of 45 years with the option to renew for an additional 30 years. The transfer is subject to a number of conditions including environmental

compliance and state and federal approvals. In November 1998, Metropolitan and SDCWA reached a 30-year exchange agreement. Under the agreement, SDCWA will make up to 200,000 af of conserved water available to Metropolitan annually, and Metropolitan will deliver an equal amount of exchange water to SDWCA. Performance of obligations under the agreement is subject to specific conditions, including:

- Completion of a process that resolves the quantification of agricultural water entitlements, thus assuring that water conserved from reasonable and beneficial uses can be transferred from an agricultural to an urban agency.
- Application by the Secretary of surplus guidelines for Lake Mead that are sufficient, together with those other supplies that are under the control of Metropolitan, to assure that the CRA is full at least through 2015.
- The use of \$235 million from the State General Fund to assist in implementing the California Plan, of which \$200 million would be used for lining portions of the All American Canal and Coachella Canal and \$35 million would be utilized for groundwater conjunctive use programs.

#### All American Canal and Coachella Canal Lining

In 1988, Public Law 100-675 authorized the Secretary to construct a concrete-lined canal parallel to the existing earthen All American Canal from the vicinity of Pilot Knob to Drop 4, and to concrete line the earthen Coachella Canal from Siphon 7 to Siphon 32. It also authorized the Secretary to enter into a construction or funding agreement with one or more of the California contractors holding a delivery contract for Colorado River water.

Reclamation released a Revised and Updated Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the Coachella Canal Lining Project in September 2000. The preferred alternative is to build a lined canal in the existing cross section (while bypassing the canal flow using temporary pipelines). This alternative is estimated to conserve approximately 26,000 af per year.

Reclamation released the Final EIS/EIR for the All American Canal Lining Project in March 1994. The preferred alternative is the construction of a parallel concrete-lined canal from Pilot Knob to Drop 3 (a length of about 23 miles) that would conserve approximately 67,700 af per year.

#### The Proposed Quantification Settlement

The Quantification Settlement (Settlement) proposed by the California agencies represents an important recent development in the management of Colorado River supplies. On October 18, 1999, the respective boards of CVWD, IID, Metropolitan, (collectively, the districts) and the State of California released the Key Terms for Quantification Settlement (Key Terms) as the basis for obtaining public input and completing a Quantification Settlement among the districts.

Currently, there is no further division of the first three priorities' rights to use no more than 3.85 million af per year. Quantification of rights and uses of Colorado River water with respect to Priorities 3a and 6a of the 1931 California Seven-Party Agreement will help facilitate the implementation of cooperative water supply programs, and it will provide a needed baseline by which conservation and transfer programs can be measured. The settlement would help California reduce its reliance on Colorado River water above its normal

apportionment. In addition, it would further quantify the rights and uses of Colorado River water by designating base entitlements. The base entitlements would be 3.1 million af per year for IID, and 0.33 million af per year for CVWD. These would combine with the 0.42 million af per year average use by PVID and the Yuma Project (Reservation Division) to equal 3.85 million af.

The Settlement proposes that when California is limited to 4.4 million af per year, Metropolitan, under the 3rd, 4th, and 5th priorities, will be able to receive from 771,000 to 851,000 af per year with transfers and other adjustments. In years when there are insufficient Colorado River supplies available to divert 1.25 million af into the Colorado River Aqueduct (Aqueduct) from Lake Havasu, other supplies will be substituted to permit delivery of this amount of water through the Aqueduct. Use of Priority 1 and 2 water by the Palo Verde Irrigation District and the Yuma Project (Reservation Division) will continue unchanged.

Further aspects of the draft settlement are outlined below:

1. It provides for a shift of 380,000 af per year from agriculture to urban use on the coastal plain of Southern California. This water will be provided to Metropolitan, SDCWA, and the San Luis Rey Indian Water Rights Settlement parties through conservation, reducing the amount of water needed by IID and CVWD. It also entails forbearance of the utilization of 38,000 af per year of Priority 6a water by IID and CVWD for Metropolitan's use.
2. It provides the districts the ability to acquire Colorado River water from entities other than the districts without objection, as long as the acquisition does not materially reduce the water available to the districts under the proposed Settlement.
3. It caps the use of water by IID and CVWD under the 3a Priority.
4. It has a term of up to 75 years, which may be extended.
5. It provides Metropolitan with the exclusive right to use all water below 420,000 af per year that is unused by PVID and the Yuma Project (Reservation Division) collectively. It also assigns responsibility for reducing the use of Colorado River water to Metropolitan if use by these two entities collectively exceeds this long-term average.
6. It provides Metropolitan the first opportunity to be the transferee under any defensive transfer agreement proposed by IID. Such a defensive transfer could occur if IID were threatened with loss of part of its entitlement through federal or state action and were permitted to enter into a conservation-based transfer to defend that entitlement.
7. It permits Metropolitan to challenge a proposed IID transfer, other than a transfer of up to 30,000 af per year within Imperial County, on any grounds, as long as that challenge is limited in scope as to whether the proposed transfer can or cannot be made.
8. It provides a permanent water supply of 16,000 af per year for the San Luis Rey Indian Water Rights Settlement that will come from the All American and Coachella Canal Lining Projects.
9. It addresses deductions from IID, CVWD, and Metropolitan's supplies to permit the

Secretary to satisfy the use of miscellaneous and Indian PPRs by holders of those rights. Those rights were not quantified until 1979, and thus were not addressed in the 1931 Seven-Party Agreement.

10. It provides that Metropolitan may not: a) pursue any legislative, administrative, or judicial proceeding, or take any other action that would reduce IID's consumptive use entitlement, or b) divert any water that IID is ordered to conserve as the result of a challenge to IID's water supply before year 21 of the quantification period.

A number of conditions need to be satisfied prior to the Settlement becoming effective. These include:

1. Completion of appropriate environmental reviews and arrangements made for any required mitigation.
2. Receipt of a "no surprises" assurance with respect to Endangered Species Act compliance for the 200,000 af per year of water to be conserved by IID for SDCWA, and for the 100,000 af per year of water to be acquired by CVWD from IID, and for which Metropolitan has an option to use if such water is not utilized by CVWD.
3. Appointment of an independent panel to provide recommendations to the Secretary regarding whether use on the Yuma Island is charged to the 2nd Priority.
4. Adoption and implementation of standards and procedures for decree accounting by Reclamation for annual consumptive use by Priorities 1, 2, and 3b that uses a 25-year running average or an actual annual consumptive use.
5. Adoption and implementation of standards and procedures for an inadvertent consumptive use overrun and payback program by Reclamation that is acceptable to IID, CVWD, and Metropolitan.
6. Agreement by Reclamation to develop a process for establishing a statistically significant trend test for increases in use by the holders of the 1st, 2nd, and 3b Priorities.
7. Recognition that the 1998 IID/SDCWA Transfer Agreement must go forward.
8. Waiver by SDCWA of any rights under the 1998 IID/SDCWA Transfer Agreement with respect to conserved water that may be acquired by Metropolitan.
9. Concurrence that should IID transfer less than 200,000 af per year to SDCWA, but later make available additional conserved water for transfer to SDCWA, Metropolitan agrees to exchange such water up to a total of 200,000 af per year.
10. Continuation of the interim period under the Colorado River Basin Salinity Control Act.
11. Implementation of Lake Mead interim surplus guidelines acceptable to Metropolitan.
12. Completion of negotiation of San Luis Rey Indian Water Rights Settlement water arrangements.
13. Agreement with PVID relative to the use of a) conserved water from the lining of the All American and Coachella Canals, b) expansion of use on the Palo Verde Mesa, and c) rights to 6th Priority water.
14. Receipt of state and federal approvals and permits required for the implementation of all of the Quantification Settlement water budget components.

15. Ratification, execution, and delivery by the districts of all legal documents and agreements necessary to implement the Quantification Settlement.

16. Execution by IID and CVWD of an agreement regarding the sharing of liability in Salton Sea flooding cases.

#### Surplus Guidelines

Currently, the Secretary determines the availability of surplus water on a year-to-year basis, based on a recommendation by the Commissioner of Reclamation. In recent years, requests for Colorado River water in Arizona, California, and Nevada have exceeded the collective normal apportionments of 7.5 million af. Surplus determinations allow the use of water above the 7.5-million acre-foot normal apportionment. Through the Annual Operating Plans for the Colorado River System Reservoirs, surplus determinations have been made from 1996 through 2000, and Reclamation is currently considering a surplus declaration for calendar year 2001. Surplus water is projected to be available in the future from time to time.

A need has existed for specific guidelines to direct the Secretary's annual decision regarding the availability and quantity of surplus Colorado River water. These surplus guidelines would allow more flexible and efficient use of water from Lake Mead, while contributing to the capture of additional water from above normal runoff years and reducing Colorado River salinity concentrations in Lake Mead. Reclamation estimates that salinity concentration in Lake Mead will decrease up to 7 milligrams per liter by 2005, depending on the alternative analyzed. The guidelines would afford entities that have contracted for surplus water a greater degree of predictability with respect to the annual existence of surplus

water available for diversion, which would help them manage their water resources.

In July 2000 Reclamation released for public comment a draft environmental impact statement (DEIS) for the proposed adoption of Colorado River interim surplus guidelines. These guidelines would guide the determination of the availability of surplus water for use in Arizona, California, and Nevada during a 15 year period. The DEIS presents four possible alternatives for implementation, plus a "no action" alternative:

1. "Flood Control Alternative," which would provide surplus water only when flood control releases from Lake Mead are needed, based on the current criteria for making such releases.
2. "Six States Alternative" and
3. "California Alternative." Both of these allow for different levels of surplus to be declared. The alternatives specify various Lake Mead water surface elevations to be used as "triggers" to indicate when each surplus condition or a normal condition exists.
4. "Shortage Protection Alternative," which would permit a surplus condition to be determined when water levels are above a specific elevation. This elevation is adequate to ensure that enough water remains in Lake Mead to provide a one-year water supply to Arizona, California, Nevada, and Mexico, and to protect against the water level of the lake dropping below a specified minimum elevation.

Alternative 4 represents the most liberal alternative, and it makes the most water available.



After the release of the DEIS, a fifth alternative was submitted by the Colorado River Basin states in the "Interim Surplus Guidelines - Working Draft." This alternative also determines the amount of surplus water available based on Lake Mead water surface elevations and other conditions. Potential effects of this alternative fall within the range bounded by the Six States Alternative and the California Alternative. A Record of Decision on interim surplus guidelines is expected in January 2001.

#### Conjunctive Use

The California Plan recognizes the need for California to enhance its water supply through conjunctive use programs. Opportunities to use ground and surface water conjunctively are being explored using the Coachella groundwater basin, other groundwater basins near the CRA, and the Arizona Water Bank.

#### *Desert Water Agency and Coachella Valley Water District*

As part of the Quantification Settlement, Metropolitan would transfer 35,000 af per year of its SWP water to CVWD. To receive the additional water, CVWD would exchange that water for an equal quantity of Metropolitan's Colorado River water.

Metropolitan is also exploring additional programs with DWA and CVWD. Under the current Advance Delivery Program, Metropolitan delivers water near the Whitewater Recharge Area for the upper Coachella Valley groundwater basin underlying the DWA service area. The upper basin is nearing capacity and the lower basin is overdrafted. The hydraulic relationship between the upper and lower basins has yet to be determined. Metropolitan's board has authorized \$750,000 for feasibility studies for a conjunctive use program that would store water in the lower basin. This new program

could provide Metropolitan with the right to receive 100,000 to 150,000 af per year, over a 10-year cycle. In addition, Metropolitan is considering the transfer of 100,000 af per year of its SWP entitlement to DWA and CVWD. DWA and CVWD would provide additional water supplies to Metropolitan when the SWP reduces deliveries to Metropolitan. This proposal is currently undergoing an environmental impact review.

#### *Other Conjunctive Use Projects*

Three groundwater basins near Metropolitan's Colorado River Aqueduct in the Mojave Desert east of Palm Springs have been under consideration for conjunctive use projects. In 1998, Metropolitan's board of directors authorized demonstration projects, environmental review, and technical studies for these basins. One of these was the CVWD program for recharge of the lower basin outlined above. Two additional projects being considered for storage are the Cadiz Valley and the Hayfield and Chuckwalla groundwater basins.

#### *Cadiz Groundwater Storage and Dry-Year-Supply Program*

This proposed program is between Metropolitan and Cadiz Inc, a publicly traded agricultural and water development company. The proposed project is located in the Mojave Desert in eastern San Bernardino County, about 30 miles north of Metropolitan's Iron Mountain Pumping Plant. With this project, Metropolitan proposes to utilize the groundwater basins underlying a portion of the Cadiz and Fenner Valleys to store Colorado River water conveyed through the CRA during periods when the water is available. When needed, the stored water and indigenous groundwater would be extracted by wells and returned to the CRA for use within Metropolitan's service area. All Cadiz Project operations would be governed by the

provisions of a groundwater monitoring and management plan (management plan). An annual maximum of 150,000 af of Colorado River water could be delivered and stored in the basin. Up to 1 million af of Colorado River water could be stored at any one time. In addition, indigenous groundwater would be transferred to Metropolitan to meet dry-year needs, subject to the provisions of the management plan. Up to 150,000 af of stored and/or indigenous water could be withdrawn annually and delivered to the CRA.

Metropolitan and the Bureau of Land Management (BLM) are jointly preparing required environmental documentation for the proposed project. In November 1999, Metropolitan and the BLM released a Draft EIR/EIS for the project. A Supplement to the Draft EIR/EIS was circulated for public review in October 2000. Final environmental documentation for the project will be completed in 2001. The proposed project ultimately will require Metropolitan Board approval.

#### *Hayfield and Chuckwalla Groundwater Storage Programs*

When Metropolitan was building the CRA, it acquired land for a small surface reservoir adjoining the pumping plant at Hayfield, between Palm Springs and Desert Center. When this natural basin adjoining the pumping plant was filled with water in 1939, it failed to retain that water. Investigations showed that the bottom of the reservoir was too porous to hold water, and the planned surface reservoir was cancelled. However the land was retained.

Metropolitan is now implementing a groundwater storage program in the Hayfield basin. Metropolitan's Board has authorized \$9.6 million to begin implementing this program. Metropolitan's Board has also authorized a feasibility investigation of the Upper Chuckwalla Groundwater Basin for a

similar program. These two valleys are located in the Mojave Desert near the Julian Hinds Pumping Plant and the Eagle Mountain Pumping Plant respectively. The aquifers are estimated to provide up to 1 million af of underground storage capacity, with recharge and withdrawal capacity of up to 150,000 af per year. Approximately 58,600 af were stored in the Hayfield Groundwater Basin during the demonstration program.

Spreading facilities and extraction wells will be constructed during implementation of the full-scale project. In addition, Metropolitan will monitor evaporation, water quality, and water level information during the life of these programs.

#### *Arizona Water Bank*

Interstate offstream water banking of unused basic and/or surplus Colorado River water apportionments provides an added water management opportunity for meeting the water supply needs of the Lower Division states. On November 1, 1999, the Department of the Interior issued a Final Rule to facilitate voluntary interstate offstream storage of Colorado River water among Arizona, California and Nevada. The Final Rule establishes a framework for the Secretary to follow in considering, participating in, and administering storage and interstate release agreements among entities in Arizona, California, and Nevada. The final rule will permit state-authorized entities in Nevada and California to store Colorado River water offstream in groundwater basins in Arizona, develop intentionally created unused apportionment (ICUA), and make ICUA available to the Secretary for release and use in another Lower Division state that is party to a storage and interstate release agreement. The Department's stated intent of the rule is to increase the efficiency, flexibility, and certainty in Colorado River management.

In 1996, the Arizona Legislature created the Arizona Water Banking Authority (AWBA). It was created specifically to protect Arizona's supply of Colorado River water and to provide opportunities for interstate banking. Its major objective is to store Arizona's unused Colorado River water entitlement in western, central, and southern Arizona to develop long-term storage credits to: (1) firm existing water supplies for Arizona's municipal and industrial users during Colorado River shortages or CAP service interruptions; (2) help meet the water management objectives of the Arizona Groundwater Code; and (3) assist in the settlement of Indian water rights claims in Arizona. The statute provides a role for interstate storage programs, limiting the annual recovery amount to no more than 100,000 af in total for entities in California and Nevada.

Each year, the AWBA pays the delivery and storage costs to convey what would otherwise be unused Arizona Colorado River water into central and southern Arizona through the CAP. The water is stored underground in aquifers (direct recharge), or it is used by water agencies in lieu of pumping groundwater (indirect storage). For each acre-foot stored, AWBA accrues a credit that can be redeemed in the future.

Both the Southern Nevada Water Authority (SNWA) and Metropolitan are currently in discussions with AWBA regarding participation in the Arizona water bank to make more effective use of Colorado River apportionments and surplus water in meeting future water needs. SNWA is seeking to accumulate 1.2 million af of unused apportionment or surplus Colorado River water during the interim surplus guidelines period. This and the storage of future surplus Colorado River water are part of its program to meet future needs.

Metropolitan is seeking to use the Arizona water bank to store surplus Colorado River water for a number of reasons:

- To assist in its transition to its basic apportionment
- To help mitigate incremental impacts caused by the use of interim surplus guidelines
- To guard against critical year hydrology
- To make more effective use of surplus Colorado River water to meet long-term needs

Metropolitan may accumulate up to 2 million af of stored water collectively in the Arizona water bank and the lower Coachella Valley, with an annual storage and extraction of up to 200,000 af per year.

#### Environmental Protection

In 1994 the U.S. Fish and Wildlife Service (USFWS) designated critical habitat for three endangered fish species that occur in the Colorado River below Glen Canyon Dam. This designation requires federal agencies to consult with USFWS on the potential impact on those species of any project actions within the critical habitat area. The river and its shoreline are also habitat for other species of concern.

To protect both the wildlife in the area and the federal projects' ability to operate with minimum restrictions, a regional partnership has been formed. Known as the Lower Colorado River Multi-Species Conservation Program, its goal is to protect more than 50 federal and state listed and sensitive species in the region. It has implemented critical interim conservation measures and is currently developing a plan for the next 50 years.

### ***Achievements to Date***

Metropolitan is developing a range of programs to enhance the reliability of CRA deliveries. The capacity and current storage utilization for these existing and other potential programs are summarized in Table III-18. Once the proposed programs are instituted, Metropolitan will potentially have enough

storage and withdrawal capacity to assure a full aqueduct for a number of decades. However, without implementation of the proposed programs, sufficient supplies would not be available to keep the aqueduct full when surplus water is not available. Adoption of surplus guidelines for Lake Mead could resolve this issue for the next 15 years.

**Table III-18**  
**Projects for**  
**Management of Colorado River Water Supplies**  
(acre-feet)

Agreement	Storage Capacity <sup>1</sup>	Current Storage Level <sup>2</sup>	Actual or Potential Annual Deliveries (af) <sup>1</sup>
<i>Dry-year deliveries</i>			
DWA/CVWD Advance Delivery	600,000	261,600	61,200
Proposed CVWD Groundwater Storage Program	CN	NA	CN
Proposed Metropolitan/DWA/CVWD Entitlement Transfer Program	100,000	NA	CN
Proposed PVID Land Fallowing Program	NA	NA	100,000
Arizona Groundwater Demonstration Storage Program	300,000	89,000	80,000 <sup>3</sup>
Proposed Cadiz <sup>4</sup> Groundwater Storage Program	1,000,000	NA	150,000
Proposed Hayfield/Chuckwalla Groundwater Storage Program	1,000,000	58,600	150,000
<i>Total Dry Year</i>			541,200
<i>All-year deliveries</i>			
IID-Metropolitan Water Conservation Program	NA	NA	109,460 <sup>5</sup>
Proposed IID-SDCWA Transfer and SDCWA-Metropolitan Exchange	NA	NA	200,000
Proposed All-American Canal Lining Program	NA	NA	67,700 <sup>6</sup>
Proposed Coachella Canal Lining Program	NA	NA	26,000 <sup>6</sup>
<i>Total all-year deliveries</i>			403,160

<sup>1</sup> CN= under contract negotiations, NA= currently not applicable. Not applicable, either because the program is proposed or because the program does not currently have a storage component.

<sup>2</sup> As of November 2000.

<sup>3</sup> Amount of water that can be recovered when Arizona's Colorado River supply is at least 2.8 million af.

<sup>4</sup> The Cadiz Program includes a water transfer component, as well as a storage component.

<sup>5</sup> Under the proposed Quantification Settlement, 90,000 af would be available to Metropolitan.

<sup>6</sup> Of the potential annual deliveries, under the proposed Quantification Settlement, 16,000 af of water from the proposed lining projects would be made available annually to facilitate implementation of the San Luis Rey Indian Water Rights Settlement.



### III.6 STATE WATER PROJECT

#### Planning Goals

Improving the water supply reliability of the State Water Project (SWP) is a primary focus of Metropolitan's long-term planning efforts. Restoring and stabilizing the health of the Bay-Delta through the implementation of CALFED's Bay-Delta Program is a necessary step to accomplishing this objective. These improvements will provide the regulatory certainty needed to better manage Bay-Delta supplies for the benefit of all its users. They are essential if Metropolitan is to attain its supply goals of 650,000 af in dry years and an average of 1.5 maf over all year types as described in its policy statements regarding the Bay-Delta and CALFED. This section describes the SWP programs Metropolitan has instituted to attain its goals for SWP supplies.

Deteriorating reliability and quality of SWP supplies require that decisive actions be taken to resolve Bay-Delta conflicts and begin programs to "fix the Delta." In August of 2000, CALFED's Bay-Delta Program laid out final implementation plans for the first phase – the first seven years – of what is conceived to be up to 30 years of improvements in the Bay-Delta. Metropolitan's strategy is to reduce its dependence on SWP supplies during dry years, when risks to the Bay-Delta ecosystem are greatest. This strategy depends on successful implementation of the CALFED program to provide regulatory stability, improvements in drinking water quality, salinity control, and water supply reliability. Meeting these objectives will enable Metropolitan to better utilize SWP surplus supplies, increase conjunctive use programs, and advance local resource programs.

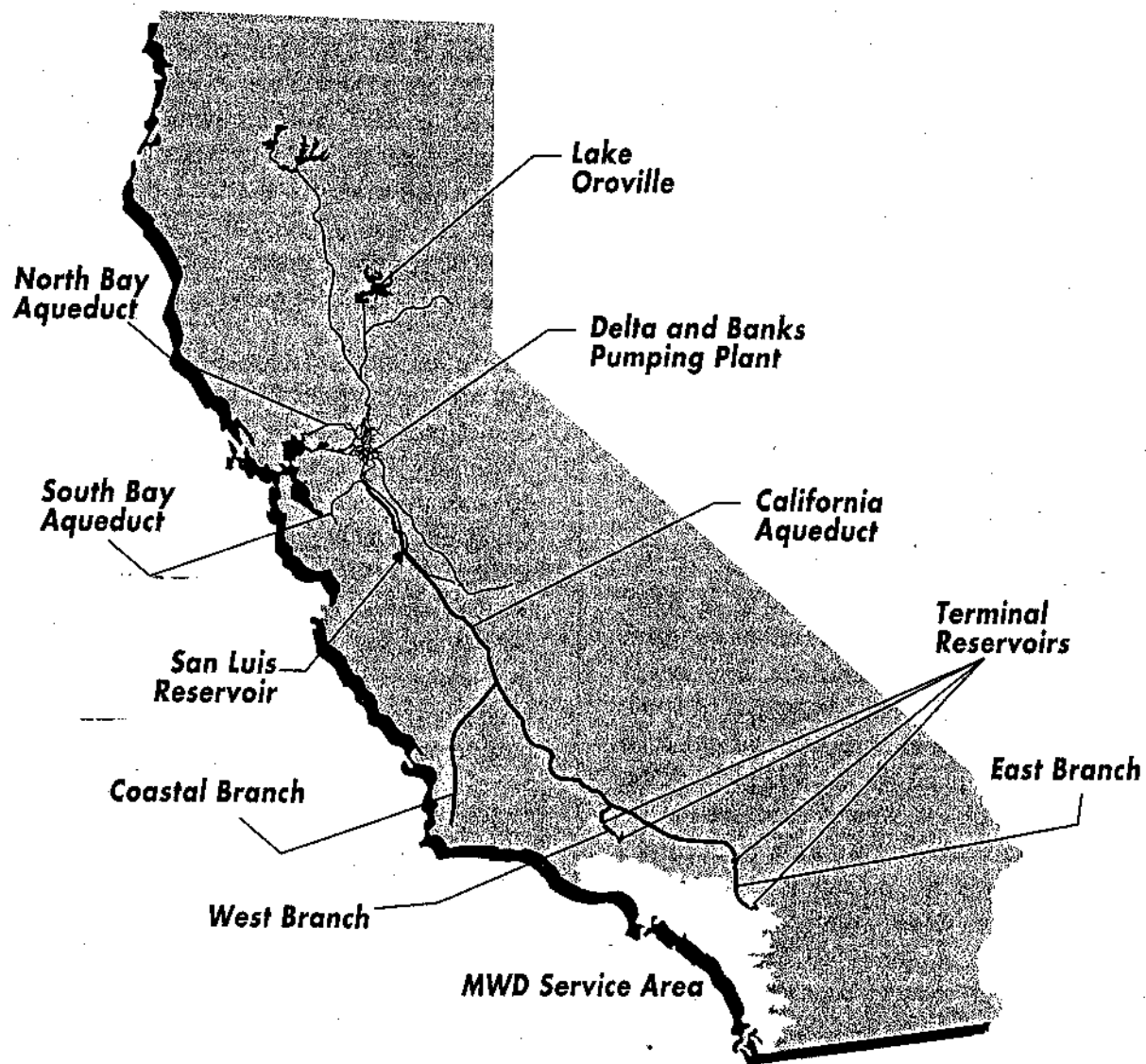
#### SWP Supply Reliability

The SWP conveys water from the western slope of the Sierra Nevada mountains to water users both north and south of the Bay-Delta through a series of reservoirs, pumping plants, and aqueducts. Figure III-6 shows the major facilities of the SWP. Owned and operated by the California Department of Water Resources (DWR), the SWP provides municipal and agricultural water to 29 State Water Contractors. Annual deliveries for the total SWP average about 2.5 maf. Municipal uses account for about 60 percent of annual deliveries, with the remaining 40 percent going to agriculture.

Simulation studies done by DWR indicate that existing SWP facilities have only a 60 percent chance of meeting full delivery requests based on 1995-level demands, and only a 15 percent chance of delivering Metropolitan's 2 maf entitlement in any given year (DWR Bulletin 160-98, page 3-33). These estimates are far below contractor entitlements, and by not accounting for export restrictions due to Endangered Species Act take limits, they probably overstate expected reliability for the current project status.

Improving SWP supply reliability is fundamental to Metropolitan's overall water management objectives. Metropolitan has made a number of strategic investments and agreements in this regard. Most notable among these are the groundwater banking programs with Semitropic and Arvin-Edison, Water Storage Districts (discussed in Section III.4) and the SWP terminal reservoir re-operation agreements authorized under the Monterey Amendment to Metropolitan's SWP contract (discussed in Section III.3). These programs are essential components of Metropolitan's overall strategy to reduce dry-year SWP dependency by obtaining additional SWP surplus water during wet years.

**Figure III-6**  
**The State Water Project**  
**Major Facilities**





## **SWP Water Quality**

Metropolitan requires a safe drinking water supply from the Bay-Delta to meet current and future regulatory requirements for public health protection. Finding cost-effective ways to reduce total organic carbon (TOC), bromide concentrations, pathogenic microbes, and other unknown contaminants from Bay-Delta water supply is a top priority.

Metropolitan also requires a SWP supply that is consistently low in salinity – Total Dissolved Solids (TDS) – to blend with the higher salinity Colorado River water to achieve salinity goals for its member agencies. In addition, a consistently low-salinity SWP is required for Metropolitan to increase in-basin water recycling and groundwater management programs. These programs, essential to successful implementation of Metropolitan's planning goals, are contingent upon meeting blended water TDS thresholds.

### Water Quality Objectives

Metropolitan has outlined a number of objectives to improve Bay-Delta water quality. In this regard, Metropolitan will work vigorously to ensure the following outcomes:

- The ability to meet increasingly stringent public health regulation of disinfection by-products and water-borne pathogens through a cost-effective combination of source water quality improvements, source water blending, and treatment facility upgrades.
- The implementation of CALFED's Framework Agreement projects, which are designed to meet agreed-to water quality performance milestones capable of meeting anticipated safe drinking water requirements.

- The implementation of projects to meet agreed-to salinity management milestones enabling Metropolitan to cost-effectively meet a 500 mg/L salinity threshold for blended SWP and CRA water supply.
- Procure funding for research into advanced treatment and ultraviolet (UV) disinfection that may be necessary for meeting safe drinking water and salinity management objectives.
- Achieve the most cost-effective mix of investments in source water quality improvements and post-diversion treatment to meet stated water quality and salinity control objectives.
- Execute water quality exchanges in the San Joaquin Valley that provides Metropolitan with high quality Sierra water from the east side of the San Joaquin Valley.

## **SWP System Outage**

The SWP is increasingly vulnerable to natural disasters as its infrastructure ages. This is particularly true of the Delta levee system and the California Aqueduct, both susceptible to floods and earthquakes, and both key project elements. The loss of either would shut down the SWP, affecting the welfare of millions. Additionally, interruptions in East Branch service caused by aging infrastructure are becoming more frequent and more difficult to manage. While Metropolitan has made substantial investments in local resources and in-basin storage to insulate Southern California against loss of its imported water supplies, renewed investment in the infrastructure is also needed.

Specific Metropolitan objectives include:

- **Delta Levee System.** The SWP is vulnerable to Bay-Delta levee failures. Many levees are structurally weak or not properly maintained. They present a high risk of failure, particularly during an earthquake or during periods of high runoff. Levee failures could result in rapid seawater intrusion into the Delta, contaminating the SWP supply and potentially interrupting deliveries to millions of water users. Metropolitan will continue to support DWR's Delta Levee Maintenance and Subventions Program and Special Flood Protection Projects, as well as CALFED's Long-term Levee Protection Plan, as described in the Framework Agreement.
- **Arroyo Pasajero.** The California Aqueduct traverses the Arroyo Pasajero's alluvial fan along its alignment in the San Joaquin Valley. The Aqueduct effectively forms a barrier to Arroyo flood flows. While flood control facilities were developed to protect the Aqueduct, the volumes of runoff and sediment deposition are much greater than originally estimated, and a significant flood risk remains. The Aqueduct was severely damaged during March of 1995, when a significant flood overwhelmed flood control facilities and overtopped the Aqueduct with 10,000 af of flood water and an estimated 800,000 cubic yards of sediment. Impacts to downstream water users lasted through the summer of 1995. The Corps of Engineers has recently completed studying alternative flood control measures for the Arroyo Pasajero. Both of the proposed alternatives were considered unacceptable, so another alternative is being proposed for study to reduce flood risks along this stretch of the Aqueduct. Additional measures may be required to address several other stream groups that

also pose risks to the Aqueduct. Metropolitan is working closely with other State Water Contractors and DWR to identify cost-effective options to reduce flood risks and to share costs equitably among local, state, and federal project beneficiaries.

- **East Branch Preventive Maintenance.** Metropolitan is working closely with DWR to develop preventive maintenance programs along the East Branch of the SWP that will help to reduce the number of unplanned outages and improve the scheduling of routine maintenance. The goal of these programs is to minimize disruptions to deliveries during peak demand periods to the greatest extent possible.

### ***Programs to Meet Goals***

Metropolitan continues to work on a number of fronts to secure both near-term improvements in SWP reliability and long-term solutions to Bay-Delta issues that directly affect SWP delivery capability. These activities include:

#### Vernalis Adaptive Management Program (VAMP)

By improving habitat conditions for San Joaquin River fall-run salmon and providing real-time monitoring of SWP and CVP operations on San Joaquin River salmon fisheries, the VAMP is expected to provide a more stable regulatory environment for Bay-Delta exporters, thereby allowing more flexible SWP and CVP operations. Metropolitan is currently working with VAMP stakeholders to address concerns of Delta water users and gain approval by the SWRCB.

### Bay-Delta Water Rights Proceedings

Along with other SWP contractors, Metropolitan is working to ensure that the burden of meeting flow requirements set out by the 1995 Water Quality Control Plan is fairly shared across all Bay-Delta water users. Currently, the SWP and CVP are voluntarily meeting the full burden of these standards. Following the conclusion of the current State Board hearing process, Metropolitan anticipates that a more equitable distribution of responsibility will result in measurable improvements in SWP supply reliability.

### CALFED Bay-Delta Program

Metropolitan has worked cooperatively with CALFED and other stakeholders for five years in the CALFED process to develop solutions for Bay-Delta problems that meet CALFED objectives in a balanced and cost-effective manner. On August 28, 2000, the CALFED agencies approved the Bay-Delta Program, concluding the environmental review process. The approved program calls for implementation over the next seven years of many actions identified during the CALFED planning process. It provides the foundation for a new entity to implement a far-reaching program in the Bay-Delta watershed designed to restore the environment, improve water quality, and increase supply reliability over the next 20 to 30 years.

The program promises to link the achievement of environmental benefits with water quality and water supply improvements. It requires annual reports to the U.S. Secretary of the Interior, the Governor of California, and the State Legislature to assure that all interests are realizing benefits. The following sections summarize the key components of the Bay-Delta Program.

### *Water Quality: The Bay-Delta Program*

The program commits to a mix of strategies to improve water quality, including actions to allow the capture of water during periods of higher quality, source control of salinity and other contaminants, and treatment technologies. Specific actions include:

- Implement programs to manage salt loadings in the San Joaquin Valley
- Implement source control programs to reduce contaminants from Delta and upstream sources
- Invest in water treatment technology demonstration projects for UV disinfection and desalination
- Control runoff into the California Aqueduct with the construction of necessary physical improvements

The Bay-Delta Program contains an aggressive mix of water quality improvement actions. Metropolitan's main concern is to assure timely implementation of program elements that will maximize water quality benefits and support efforts to fully comply with future drinking water standards at the lowest possible cost.

### *Ecosystem Restoration*

The goal of the ecosystem restoration element is to improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta system. Improvements in the ecosystem health will reduce the conflict between environmental water use and other beneficial uses, and they will allow more flexibility in water management decisions.

### *Water Supply Reliability*

Metropolitan is focused on stabilizing the reliability of current water delivery levels by implementing measures that add operational flexibility. The Bay-Delta Program includes regulatory assurances and actions to protect near-term reliability. For the SWP, the program promises no near-term reductions in supply and specifies future actions for moderate supply increases.

The Bay-Delta Program provides near-term reliability, but it contemplates only modest increases in export supplies in the future. Instead, it relies to a much greater extent on local investments to promote reliability. If the intended assurances are implemented, and assuming reasonable operating rules for the proposed new facilities, this package of actions would likely allow Metropolitan to meet its 2020 State Water Project minimum supply goals of 650,000 af during a repeat of critical drought years such as 1977 or 1991, an average annual delivery of 1.5 million af over all years, and supply improvement of at least 200,000 af per year in less-extreme dry years. Meeting these reliability goals will depend to a great degree on CALFED's commitment to regulatory assurances.

### *Storage and Conveyance*

The Bay-Delta Program acknowledges that additional storage is essential to the successful implementation of all aspects of the CALFED Program. It provides for the development of up to 950,000 af of new surface storage capacity and up to 1 maf of new groundwater storage capacity in Stage 1. Altogether, it envisions up to 4.75 million af of new storage capacity in the long term, with up to 2 million af of new surface and groundwater storage capacity in operation or under construction before the end of Stage 1.

The Bay-Delta Program also commits to through-delta conveyance improvements, such as channel enlargements, the possibility of a screened Sacramento River water diversion to the Central Delta, and South of Delta programs.

### *Environmental Water Account*

The establishment and implementation of a workable Environmental Water Account (EWA) would help alleviate the frequent conflict between SWP/CVP project operations and fishery protection goals. The EWA is also a key element of the Program's proposed regulatory assurance commitments. CALFED agencies have approached Metropolitan regarding a partnership agreement where CALFED would compensate Metropolitan for needed EWA services, such as SWP demand shifting or temporary storage leasing.

### *Water Use Efficiency*

The Bay-Delta Program proposes significant investments in water-use efficiency during the first years of Stage 1, with 25 percent from federal sources, 25 percent from state sources and 50 percent from local matching funds. It also establishes the following annual targets: urban conservation savings of 520,000 to 680,000 af; agricultural savings of 260,000 to 350,000 af; and savings from water recycling of 225,000 to 310,000 af.

The Bay-Delta Program emphasizes incentives to encourage voluntary conservation and proposes to provide supplemental funding for urban and agricultural water use efficiency measures and water recycling projects through a combination of "competitive" loans and grants. Loans would primarily be used to assist conservation program start-up and capital costs. Grants would be used to assist conservation measures that, while not locally cost-effective, would prove beneficial from a statewide perspective.

### *Water Transfers*

The Bay-Delta Program encourages a more effective water transfer market by streamlining regulatory approvals and by creating an Internet-based (online) Water Transfers Information Clearinghouse. It also calls for increasing the availability of existing transportation facilities for water transfers.

### *Levees*

The Bay-Delta Program provides for the stabilization and improvement of Delta levees to protect in-Delta as well as export users. The levee element includes four main components: (1) Base level protection, (2) Special improvement projects, (3) Levee subsidence control plan, and (4) Emergency response. These actions should increase supply reliability by providing safeguards against system failure and help ensure protection of water quality.

### *Science*

The Bay-Delta Program commits to a science program to guide adaptive management decisions. The program includes the appointment of an eminent lead scientist to be assisted by an Independent Science Board. The Board will issue annual reports regarding the status and effectiveness of program measures and will recommend adjustments. CALFED has already appointed a lead scientist to serve in this capacity on an interim basis for 18 months, until a permanent lead scientist can be appointed through a nationwide search program.

### *Governance*

The Bay-Delta Program envisions legislation to create a new public agency with implementation powers, headed by an Executive Director who will report directly to the Governor and Secretary of the Interior. The Program also envisions a 12-member, high-level federal-state commission to assure

effective, balanced and coordinated implementation, with four state, four federal and four stakeholder representatives, including an urban water user representative. In addition, the proposed governance structure includes appointment by the Governor and Secretary of Interior of a Stakeholder Technical Advisory Committee, a Lead Scientist, an Independent Scientific Review Board and Panel, and the appointment of a Governor's Drought Contingency Panel.

### *Finance*

The Bay-Delta Program envisions over \$8 billion of investments to implement the first seven years of program actions. On a gross scale, the overall cost-share assumptions assume an equal distribution of the program costs among state, federal, and user/local funds. Final cost-share arrangements will depend on the specific projects that are implemented, and they will vary year by year. Initial years will be heavily funded by federal and state dollars. This initial funding will not include the cost of constructing the major storage or conveyance elements. Final cost shares, including reimbursement of up-front funding, are intended to be based upon a "beneficiaries pay" principle.



## IV. WATER QUALITY

### Planning Goals

All of Metropolitan's recent planning efforts, including the IRP, have emphasized the central importance of water quality. In addition to health and safety considerations, water quality also has supply quantity implications for Metropolitan. The overall message of Metropolitan's Water Quality Initiative is, "protecting it at the source so you can trust it at the tap."

The following factors demonstrate the influence of water quality on the level of supplies needed for Metropolitan's member agencies:

1. If a groundwater basin becomes contaminated and cannot be used, more water will be required from other sources.
2. Imported water from the Colorado River must be blended (mixed) with lower-salinity water from the SWP. Higher salinity levels in either Colorado River water or groundwater would increase the proportion of SWP supplies required to meet the adopted imported water salinity objectives.
3. High total dissolved solids (TDS) in water supplies leads to high TDS in wastewater, which lowers the usefulness of the water and increases the cost of recycled water.
4. If diminished water quality causes a need for membrane treatment, this process typically results in losses of up to 25 percent of the water processed. These losses

result in an increased requirement for additional water supplies. In addition, the process is costly.

5. Degradation of imported water supply quality could limit the use of local groundwater basins for storage because of standards controlling the quality of water added to the basins.

Implementing the major components of Metropolitan's planning efforts – groundwater storage, recycled water, and minimized impacts on the Delta – requires meeting specific water quality targets for imported water supply. Changes in drinking water quality standards (such as tightening of standards for arsenic or radon) may also impact the usefulness of groundwater supplies and ultimately increase demands on imported water supplies.

In addition to the link between water supply and water quality, Metropolitan has identified economic benefits from reductions in the TDS levels of water supplies. A simultaneous reduction in salinity levels of 100 milligrams per liter (mg/L) in both the Colorado River and SWP supplies is estimated to have economic benefits of \$95 million per year within Metropolitan's service territory. This estimate has added to Metropolitan's incentives to reduce salinity levels in the region's water supplies.

For all of these reasons, Metropolitan's Board approved a Salinity Management Policy in April 1999 that will be effective through

Calendar Year 2004. The goal of this policy is to achieve salinity levels less than 500 mg/L TDS. At the same time, the Board adopted an Action Plan consisting of the following four components:

1. Imported water source control and salinity reduction actions
2. Distribution system salinity management actions
3. Collaborative actions with other agencies
4. Local salinity management actions to protect groundwater and recycled water supplies

In addition to these general concerns over TDS levels, health issues have been raised over particular contaminants in drinking water. For Metropolitan's supplies, the major concerns have been associated with the following:

- Bromide and total organic carbon (TOC) in SWP water
- Methyl tertiary butyl ether (MTBE) in groundwater and local surface reservoirs
- N-nitrosodimethylamine (NDMA) in groundwater and treated surface waters
- Hexavalent chromium in groundwater
- Perchlorate in Colorado River and local groundwater supplies
- Arsenic and radon

### **Water Quality Initiative**

Metropolitan has developed a "Water Quality Initiative" to improve water quality for our customers. This initiative serves as an umbrella for a series of issues that directly

impact water quality in Southern California in the present, near-term, and long-term future. This initiative is also a key component of Metropolitan's supply reliability efforts. At the center of this initiative is a checklist of water quality needs that will drive specific programs, activities, and actions, including:

- Salinity in the Delta and Colorado River.
- Accelerated banning of Methyl Tertiary Butyl Ether (MTBE).
- Clean up of radioactive mine tailings seeping into the Colorado River at Moab, Utah.
- Protecting and maintaining source water quality.

These water quality needs are discussed in greater detail below. These four needs will be the focus and feature of Metropolitan external communications tailored to educate legislators, opinion leaders, and the public about the direct impacts of poor water quality on our customers and on water reliability.

The following sections discuss Metropolitan's major water quality issues and its approaches to ensuring acceptable water quality.

### **Salinity**

Within Metropolitan's service area, local sources account for approximately half of the salt loading, and imported water accounts for the remainder. All sources must be managed appropriately to sustain water quality and supply reliability goals. The following sections discuss the current salinity situation for each of Metropolitan's major supply sources.



### Colorado River

Water imported via the CRA has the highest level of salinity of all of Metropolitan's sources of supply, averaging around 700 mg/L during normal water years. Concern over salinity levels in the Colorado River has existed for many years. To deal with the concern, in 1973 the International Boundary and Water Commission approved Minute 242, Permanent and Definitive Solution to the International Problem of the Salinity of the Colorado River, and the President approved the Colorado River Basin Salinity Control Act in 1974. These initial actions were driven by high TDS in the Colorado River as it entered Mexico, as well as the concerns of the seven basin states regarding the quality of Colorado River water in the United States. To foster interstate cooperation on this issue, the seven basin states formed the Colorado River Basin Salinity Control Forum (Forum).

The salts in the Colorado River System are indigenous and pervasive. Most of these salts result from saline sediments in the Basin that were deposited in prehistoric marine environments. They are easily eroded, dissolved, and transported into the river system. The Colorado River Basin Salinity Control Program is designed to prevent a portion of this abundant salt supply from moving into the river system. The program targets the interception and control of non-point sources, such as surface runoff, as well as wastewater and saline hot springs.

The Forum proposed, the states adopted, and the Environmental Protection Agency approved water quality standards in 1975, including numeric criteria and a plan for controlling salinity increases. The standards require that the plan ensure that the flow-weighted average annual salinity remain at or below the 1972 levels, while the Basin states

continue to develop their 1922 Colorado River Compact apportioned water supply. The Forum selected three stations on the main stream of the lower Colorado River as appropriate points to measure the river's salinity. These stations and numeric criteria are (1) below Hoover Dam, 723 mg/l; (2) below Parker Dam, 747 mg/l; and (3) at Imperial Dam, 879 mg/l. The numeric criteria are flow-weighted average annual salinity values.

During the high water flows of 1983-1986, salinity levels in the CRA dropped to a historic low of 525 mg/L. However, during the 1987-1992 drought, higher salinity levels returned. During an extreme drought, CRA supplies could exceed 900 mg/L.

### State Water Project

Water supplies from the SWP have significantly lower TDS levels than the Colorado River, averaging 250 mg/L in water supplied through the East Branch and 325 mg/L on the West Branch.<sup>1</sup>

Because of its lower salinity, SWP water is used for blending with high salinity CRA water to reduce the total salinity levels of delivered water. However, both the supply and the TDS levels of SWP water can vary significantly due to hydrologic conditions in the Sacramento-San Joaquin watersheds.

The TDS levels of SWP water can also vary widely over short time periods. These variations reflect seasonal and tidal flow patterns, and they pose an additional problem for use of blending as a management tool to lower the higher TDS from the CRA supply. For example, in the 1977 drought, the salinity of

<sup>1</sup>The higher salinity in the West Branch deliveries is due to salt loadings from local streams, operational conditions and evaporation at Pyramid and Castaic Lakes.

SWP water delivered to Metropolitan increased to 400 mg/L, and supplies became limited. During this same event, salinity at the Banks pumping plant exceeded 700 mg/L. Under similar circumstances, Metropolitan's 500 mg/L salinity objective could only be achieved by reducing imported water from the CRA. Thus, it may not be possible to maintain both salinity standards and water supply reliability unless actions are taken to reduce salinity levels of the source supplies.

The CALFED Bay-Delta Program's EIS/EIR, Technical Appendix, July 2000, Water Quality Program Plan, identified targets that are consistent with TDS objectives in Article 19 of the SWP Water Service Contract: a 10-year average of 220 mg/L and a maximum monthly average of 440 mg/L. However, these objectives were set in the 1960s when Metropolitan expected to obtain a greater proportion of its total supplies from the SWP. Because of reductions in expected SWP deliveries, Metropolitan's Board believes that this is no longer sufficient, and it has adopted a statement of needs from the Bay-Delta. Under the drinking water quality and salinity targets element, the Board states its need "to meet Metropolitan's 500 mg/L salinity-by-blending objective in a cost-effective manner while minimizing resource losses and ensuring the viability of recycling and groundwater management programs."

#### Recycled Water

Wastewater flows always experience significantly higher salinity levels than the potable water supply. Typically, each cycle of urban water use adds 250 to 400 mg/L of TDS to the wastewater. Salinity increases tend to be higher where specific commercial or industrial processes add brines to the discharge stream or where brackish groundwater is infiltrating into the sewer system.

Where wastewater flows have high salinity levels, the use of recycled water may be limited or require more expensive treatment. Landscape irrigation and industrial reuse become problematic at TDS levels of over 1,000 mg/L. Some crops are particularly sensitive to high TDS levels, and the use of high-salinity recycled water may reduce yields of these crops. In addition, concern for the water quality in groundwater basins may lead to restrictions on the application of recycled water on lands overlying those basins.

These issues are exacerbated during times of drought, when the salinity of imported water supplies increases, causing increased salinity in wastewater flows and recycled water. Basin management plans and recycled water customers may restrict the use of recycled water at a time when its use would be most valuable. For effective use of recycled water projects, it is important to control the salinity level of the region's potable water sources and wastewater flows.

#### Groundwater Basins

Increased TDS in groundwater basins occurs either when basins near the ocean are over-drafted, leading to seawater intrusion, or when agricultural and urban return flows add salts to the basins. Much of the water used for agricultural or urban irrigation infiltrates into the aquifer, so where high TDS irrigation water is used or where the water transports salts from overlying soil, the infiltrating water will increase the salinity of the aquifer. In addition, wastewater discharges in inland regions may lead to salt buildup from fertilizer and dairy waste. In the 50s and 60s, Colorado River water was used to recharge severely overdrafted aquifers and prevent saltwater intrusion. As a result, more than 3 million af of this high-TDS imported water was added to groundwater basins in the region, significantly impacting salt loadings.

In the past, high salinity levels have caused some basins within Metropolitan's service area to be unsuitable for municipal uses. The Arlington Basin in Riverside and the Mission Basin in San Diego were only recently returned to municipal service after the implementation of demineralization projects. The capacity of the larger groundwater basins made them better able to dilute the impact of increasing salinity. However, approximately 600,000 tons of salts per year accumulate within the region, leading to ever-increasing salinity levels in many groundwater basins. While the majority of groundwater wells within the region still produce water of acceptable quality, this resource must be managed carefully to minimize further degradation. Table IV-1 shows the salinity from existing productive groundwater wells within the region, and Figure IV-1 shows the distribution of those salinity levels.

To protect the quality of these basins, regional water quality control boards often place restrictions on the salinity levels of water used for basin recharge or for irrigation of lands overlying the aquifers. Where these restrictions are in place, water reuse and aquifer recharge may be restricted, or expensive mitigation measures may be required.

Table IV-1  
Salinity Levels at Productive Groundwater Wells

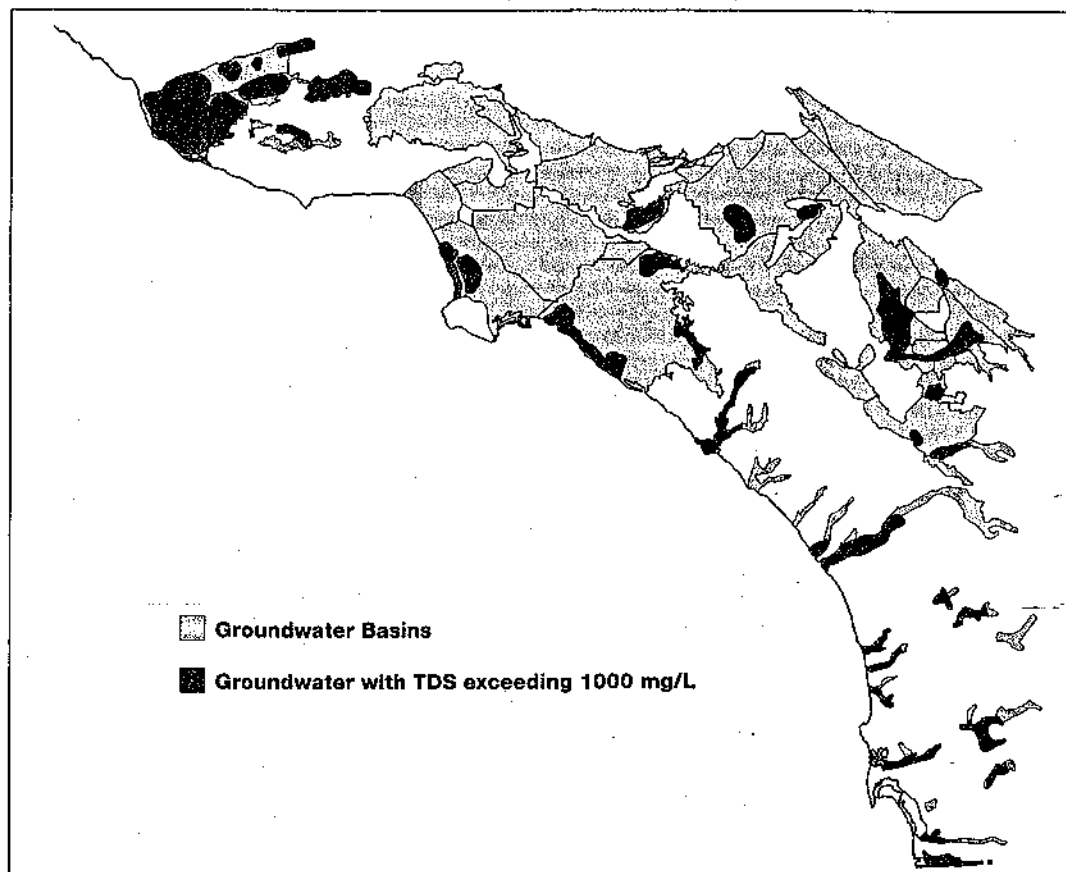
TDS Concentration (mg/L)	Annual Production (Million Acre-Feet)	Percent of Production
Less than 500	1.06	78
500 to 1,000	0.15	11
Greater than 1,000	0.15	11
Total	1.36	100
Source: Metropolitan Water District of Southern California, Salinity Management Study, Final Report, June 1999.		

### The Salinity Action Plan

Metropolitan's Board has adopted a salinity objective of 500 mg/L for blended imported water. It has also identified the need for both local and imported water sources to be managed comprehensively to maintain the ability to use recycled water and groundwater storage. To achieve this target, the Board adopted an Action Plan that relies in part on blending SWP water with supplies from the Colorado River. Using this approach, the salinity target could be met in seven out of 10 years. In the other three years, hydrologic conditions would result in increased salinity and reduced volume of SWP supplies. Metropolitan has alerted its local agencies that such conditions are inevitable, and that despite its best efforts, high salinity could be a concern at such times. Metropolitan has also urged its member agencies to structure the operation of their local projects and groundwater so they are prepared to mitigate the effect of the higher salinity levels in imported waters. In addition, Metropolitan will concentrate on obtaining higher water quality in the spring/summer months (April through September) to maximize the ability for agriculture to make use of recycled water supplies.

In the near term, Proposition 13 and the CALFED Bay-Delta Program provide funding to improve the quality of water originating in the Bay-Delta. Proposition 13 (Water Bond 2000), approved in March 2000, authorizes the State of California to sell \$1.97 billion in general obligation bonds to support safe drinking water, water quality, flood protection, and water reliability projects throughout the state. Of these funds, \$355 million are earmarked for statewide clean water and water recycling programs, and \$155 million for water conservation programs.

**Figure IV-1**  
**Distribution of Groundwater Salinity Levels in Metropolitan's Service Area**



Metropolitan is seeking to obtain Proposition 13 funding for three programs:

- The Water Supply Reliability Program. The \$45 million applied for will be used to help finance groundwater storage projects within the Metropolitan service area. These projects will enhance wet-year storage of imported water for use in dry years when there is limited supply and more competing needs.
- The Water Quality Exchange Partnership. The \$20 million applied for will be used to develop new water infrastructure to enhance and optimize the water supply, water quality and water management capabilities of agricultural and urban interests

throughout the eastern San Joaquin Valley and urban Southern California.

- The Desalination Research and Innovation Partnership (DRIP). The \$4 million applied for will help develop cost-effective advanced water treatment technologies for desalination of Colorado River water, brackish groundwater, municipal wastewater and agricultural drainage water.

Actions during the first seven years of the CALFED Bay-Delta Program include: improved salt management in the San Joaquin Valley, upstream source control, demonstration projects for ultraviolet disinfection, other desalination demonstration projects, and measures to control storm runoff into the California Aqueduct.

In the longer term, implementation of the CALFED Bay-Delta Program over the next 30 years are intended to result in reductions in both the long-term average and short-term salinity in SWP water supplies. If these reductions are not achieved, Metropolitan may need to consider desalination of Colorado River water. Given current technologies, this option is very expensive. It also would cause a reduction in the amount of water that could be delivered from the Colorado River, because part of the treated water supply would be lost in the concentrated waste brine. In addition, there would be significant cost and environmental issues related to the disposal of this brine. For these reasons, large-scale desalination of imported supply is not a viable alternative at this time. The uncertainties, however, are such that the Salinity Management Action Plan calls for an aggressive research and development program into the development of a more efficient and cost-effective desalination technology. This research is already underway through DRIP, a consortium of California water agencies and other interested parties.

#### Developing the Plan

The release of Metropolitan's Salinity Management Action Plan marked the culmination of a three-year process that began in August 1996. At that time, Metropolitan and the U.S. Bureau of Reclamation agreed to cooperate on and jointly fund a study of the sources of salinity in the water supply, problems associated with that salinity, and management options to overcome these problems. To ensure a broad level of input into the analysis, Metropolitan formed a task force of interested water, groundwater and wastewater agencies, state and local government agencies, and interested associations.

#### The Salinity Summit

As the Salinity Management Study neared completion, a Salinity Summit was held in January 1999. At this conference, 100 senior managers and technical experts representing 60 agencies discussed regional salinity issues. They considered implementation issues surrounding a regional salinity management plan, and they discussed how the region's agencies could work together to attain salinity management goals.

#### *Other Issues of Concern*

Four chemicals have been identified as being of concern in Metropolitan's water supplies. These are total organic carbon (TOC), bromide, MTBE, and perchlorate. The following sections detail the reasons for Metropolitan's concerns and the plans for overcoming these potential problems. Two other chemicals (arsenic and radon) are of potential concern because of pending regulations. Other emerging contaminants such as N-nitrosodimethylamine (NDMA) and hexavalent chromium could impact the region's water supplies; they have been identified, but the full extent of problems associated with them is uncertain.

#### Total Organic Carbon and Bromide

When source water containing high levels of total organic carbon (TOC) and bromide is treated with disinfectants such as chlorine or ozone, disinfection byproducts (DBPs) are formed. Some of the DBPs are suspected carcinogens, and some have been linked to higher incidences of miscarriages and other reproductive health effects. In December 1998, the U.S. Environmental Protection Agency (EPA) adopted more stringent regulations for DBPs, which water agencies must comply with by January 2002. EPA is also expected to promulgate even more stringent regulations in May 2002 and possibly again in 2006.

Existing levels of TOC and bromide in Delta water supplies are a significant concern for Metropolitan's ability to maintain safe drinking water supplies. Levels of these constituents in SWP water increase several fold as water moves through the Delta, due to agricultural drainage and seawater intrusion. One of Metropolitan's primary objectives for the CALFED Bay-Delta process is protection and improvement of the water quality of its SWP supplies to ensure compliance with current and future drinking water regulations. Although exact future drinking water standards are unknown, significant source water protection of SWP water supplies will almost certainly be a necessary component of meeting these requirements.

On August 17, 1999, Metropolitan's Board of Directors adopted a Statement of Needs for the CALFED Bay Delta Program. The drinking water quality and salinity targets component states that Metropolitan requires a safe drinking water supply from the Bay-Delta to meet current and future regulatory requirements for public health protection. This objective is to be achieved through reduced levels of TOC, bromide, pathogens, and other as yet unknown constituents in SWP water supplies. Further, implementation of the CALFED program should:

- Ensure the ability to meet anticipated more stringent regulations on disinfectant byproducts and pathogens to protect public health, either through water quality improvements for Delta water supplies or through a cost-effective combination of alternative source waters, source improvement, and treatment facilities. Water quality improvements need to be implemented in a timely manner to allow compliance with the effective date of the regulations.

- As an element of Stage 1 of CALFED's implementation plan, identify and commit to projects tied to the establishment of water quality performance milestones to ensure compliance with anticipated and future more stringent regulations.

CALFED's Bay-Delta Program calls for a wide array of actions to improve Bay-Delta water quality, ranging from improvements in treatment technology to safeguarding water quality at the source. These include conveyance improvements, alternative sources of supply, changes in storage and operations, and advanced treatment by water supply agencies. These conceptual actions do not completely conform to the specific requirements as outlined by Metropolitan's Board. Future adoption by CALFED of water quality improvement milestones that would assure Southern California's ability to comply with pending more stringent regulations is of particular interest to Metropolitan. —

Source water quality improvements must be combined with cost-effective water treatment technologies to ensure safe drinking water at a reasonable cost. Metropolitan is currently moving forward with plans to upgrade two water treatment facilities that treat only SWP water. These plants will be upgraded to include ozone treatment at a cost of \$263 million.

#### Methyl Tertiary Butyl Ether

MTBE is the primary oxygenate in virtually all the gasoline used in California. The use of MTBE in gasoline was mandated to achieve reductions in air pollution, including emissions of benzene, a known human carcinogen. However, this reduction in air pollution has been achieved at the expense of creating a serious groundwater and surface water contaminant. MTBE is very soluble in water and has low affinity for soil particles, thus

allowing the chemical to move quickly in the groundwater. It is introduced into surface water bodies from the motor exhausts of recreational watercraft. MTBE is also resistant to chemical and microbial degradation in water, making treatment more difficult than the treatment of other gasoline components.

The California Department of Health Services (CDHS) has adopted a primary maximum contaminant level (MCL) of 13 µg/L (micrograms/liter) for MTBE based on carcinogenicity studies in animals. MTBE also has a California Secondary Drinking Water Standard of 5 µg/L, which was established based on taste and odor concerns. Metropolitan regularly monitors its water supply for MTBE contamination. MTBE has been detected in the past years at levels of non-detect to as high as 3.9 µg/L in the treatment plant effluents, and as high as 6.4 µg/L in the source water effluents.

MTBE presents a significant problem to local groundwater basins. Leaking underground storage tanks and poor fuel-handling practices at local gas stations may provide a large source of MTBE. One gallon of gasoline (11% MTBE by volume) is enough to contaminate about 16.5 million gallons of water at 5 µg/L. Within Metropolitan's service area, local groundwater producers have been forced to close some of their wells due to MTBE. For example, the city of Santa Monica lost about 50 percent of its production wells as a result of MTBE contamination.

For the new Diamond Valley Lake, Metropolitan has taken steps to reduce the potential for MTBE contamination from recreational watercraft. The Board has authorized a non-polluting boating program for the Diamond Valley Lake that calls for a monitoring program to help ensure that neither

MTBE nor any other gasoline contaminant from motorboat fuels are found at the lake. Until such time as MTBE is eliminated from the fuel supply or non-polluting marine engines are available, no gasoline-powered boating will be permitted.

Metropolitan has supported federal and state legislation aimed at reducing the impacts of MTBE in its drinking water supply, and it is investigating treatment options. In 1999, Governor Gray Davis issued Executive Order D-5-99, which will phase out MTBE as a gasoline additive by December 31, 2002. However, there are political issues that will need to be resolved with the Federal Clean Air Act and the requirement for mandatory use of oxygenates. Until the use of MTBE is phased out, MTBE will continue to be a problem at SWP reservoirs that permit gasoline-powered boating and jet skiing.

The most likely impact of MTBE on Metropolitan is through local problems that may directly impact its member agencies. If the contamination causes reduced groundwater production, it will decrease the yield of local water supplies and increase demand for Metropolitan imported water deliveries. Member agencies that rely on groundwater aquifers that are near the surface are the most likely ones to be impacted. Improved underground storage tank requirements and monitoring, and the phase-out of MTBE as a fuel additive, will probably decrease the likelihood of MTBE groundwater problems in the future. However, it is difficult to estimate the magnitude of the problem because a small amount of MTBE can contaminate such a large volume of water.

### Perchlorate

Perchlorate is a strong oxidizer used as a main component in solid rocket propellant, and it can also be found in some types of munitions and fireworks. Perchlorate salts are readily soluble in water, dissociating into the perchlorate ion ( $\text{ClO}_4^-$ ) which is highly mobile in the groundwater. The perchlorate ion does not readily interact with the soil matrix or degrade in the environment.

The primary human health concern related to perchlorate is its effects on the thyroid. Perchlorate interferes with the thyroid gland's ability to produce hormones required for normal growth and development. Currently CDHS has adopted an action level of 18  $\mu\text{g/L}$  for perchlorate. If the action level is exceeded, CDHS recommends that utilities inform its consumers of its presence in the drinking water supply and the associated potential adverse health effects. CDHS recommends that the source supplies be removed if perchlorate levels exceed 40  $\mu\text{g/L}$ .

Perchlorate has been detected in Metropolitan's CRA water supply and in some of the regional groundwater basins. No perchlorate has been detected in Metropolitan's SWP supply. Metropolitan regularly monitors perchlorate levels in its source and finished waters and select sites in the distribution system. Measured perchlorate levels in the Metropolitan system range from no detection to about 9  $\mu\text{g/L}$ , well below the current action level developed by CDHS. A state Public Health Goal (PHG) for perchlorate is currently being developed for possible future regulatory consideration.

The following sections provide more details of the areas where perchlorate has been detected.

### *Colorado River*

Metropolitan first detected very low concentrations of perchlorate in its CRA supply in 1997. Once perchlorate was detected, Metropolitan took immediate action to determine the source by conducting extensive water quality testing upstream of Lake Havasu. As a result of the testing, Metropolitan identified the Las Vegas Wash that flows into Lake Mead as a significant source of the perchlorate. Concentrations exceeding 1,000  $\mu\text{g/L}$  have been measured in this wash. The source of this perchlorate is thought to be the ammonium perchlorate manufacturing facilities located upgradient in Henderson, Nevada. Since locating this source, Metropolitan staff have met with the U.S. Environmental Protection Agency and the Nevada Division of Environmental Protection to find ways to reduce the levels of perchlorate entering Metropolitan's CRA supply. Remediation efforts at Henderson, Nevada, are currently under way, and a reduction of perchlorate in the Las Vegas Wash has been observed. However, additional remediation efforts are required to further reduce perchlorate contamination of the CRA supply.

### *Groundwater Basins*

Perchlorate has also been detected in local groundwater basins. Some drinking water supply wells in the Raymond and Main San Gabriel Basins have been closed because concentrations exceeded the California action level. Perchlorate in these basins is thought to be from local sources that tested and manufactured solid rocket engines. The closed wells are typically located near rocket testing and manufacturing facilities (for example, Aerojet in Azusa in the Main San Gabriel Basin and the Jet Propulsion Laboratory/NASA (JPL) in Raymond Basin). In the case of the Raymond Basin, one City of Pasadena well has been shut down because of perchlorate



concentrations of approximately 100 to 125  $\mu\text{g/L}$ . In the Main San Gabriel Basin several wells have been shut down; La Puente County Water District has the highest concentrations in the Main San Gabriel Basin at approximately 200  $\mu\text{g/L}$ .

Perchlorate is still being manufactured. Ammonium perchlorate is used as the solid rocket fuel in the space shuttle and nuclear defense missiles. The handling of perchlorate has improved substantially over the years. Collection and treatment systems are now commonly used when handling the perchlorate, so the risk from future spills is minimized. However, the amount of perchlorate that is already in groundwater or the overlying soil may provide an enormous source of contamination today and long into the future. Perchlorate moves relatively easy with the groundwater, so it is possible that over time, existing plumes will expand and impact other wells. However, potentially affected wells will probably be in localized areas because few facilities use perchlorate.

Metropolitan is also conducting research and development to investigate technologies to mitigate perchlorate contamination. To date, Metropolitan staff has learned that perchlorate cannot be treated using conventional water treatment. Nanofiltration and reverse osmosis work, but at a very high cost. Local companies have also conducted work on this topic. Aerojet has implemented biological treatment in Rancho Cordova and is re-injecting the treated water into the ground. CDHS has yet to approve biological treatment for a drinking water end use, so the usefulness of this technology is limited to recharge projects. Calgon has developed an ion exchange process that does remove perchlorate, but creates a hazardous waste brine. This ion exchange process is called the ISEP continuous ion

exchange system. This ISEP system has been successfully piloted at JPL and at a location in the Main San Gabriel Basin. The treatment cost for the Calgon process is about \$300 per af excluding the cost to dispose of the waste brine. The La Puente County Water District is initiating construction of the Calgon ISEP ion exchange treatment unit (2,500 gpm) for its affected supplies.

#### Arsenic

The current state and federal MCL for arsenic in domestic water supplies is 50  $\mu\text{g/L}$ . The USEPA has proposed to lower the arsenic standard to 5  $\mu\text{g/L}$  and asked for comments on regulation at 3, 10 and 20  $\mu\text{g/L}$ . Current data suggests that western states have higher naturally occurring incidences of arsenic in water sources. The standard will impact both groundwater and surface water supplies.

Initial studies indicate that Metropolitan's water supplies have low levels of this contaminant and could likely be brought into compliance with expected standards at a minimal cost. However, some member agencies may face greater problems with compliance. A 1992 study by Central Basin Municipal Water District indicated that some of the Central Basin wells could have difficulty in complying with a lowered standard. Presumably, other basins could face similar problems. Wellhead removal of arsenic could be expensive, so member agencies might increase their use of imported water to avoid this treatment cost. Water supplies imported via the Los Angeles Aqueduct also contain some arsenic. The cost of arsenic removal from these supplies could vary significantly depending on the adopted MCL.

A study conducted by the Association of California Water Agencies (ACWA) found that an adopted MCL of 5  $\mu\text{g/L}$  would require

treatment at approximately 20 percent of the water sources in California, while an MCL of 10 µg/L would require treatment at approximately 6 percent of these sources.<sup>2</sup> Treatment for water from groundwater basins is likely to be least economic because of the need for small-scale individual treatment facilities at wellheads.

#### Radon

USEPA has proposed a radon MCL at 300 pCi/L, with an alternative standard of 4000 pCi/L if the state has an approved Multimedia Mitigation program to reduce the indoor radon risk from soil and rocks underneath homes and buildings. Aeration is widely recognized as the most appropriate treatment to remove radon, but Southern California has stringent air-quality regulations that may complicate or even prevent the use of air-stripping towers. Because of the uncertainty surrounding this proposed rule, the effect on Southern California water supplies is unclear.

#### Uranium Mill Tailings Site Near the Colorado River

A 10.5-ton pile of uranium mill tailings in Moab, Utah, is located adjacent to the Colorado River and could potentially contaminate the river in the future. The mill was owned by the Atlas Corporation, which has declared bankruptcy. Metropolitan has supported efforts to move the pile away from the river or to implement an alternative equivalent to moving the pile. Legislation to that effect has been signed by President Clinton as part of next year's defense appropriation bill. In the meantime, PriceWaterhouseCooper has been appointed trustee for the Atlas Corporation uranium mill tailings site as part of the Atlas Corporation bankruptcy proceedings. They are coordinating work to begin dewatering the pile, a first step before covering or moving it.

<sup>2</sup>Extracted from the ACWA study: *Cost of Compliance With Potential Arsenic MCLs*, conducted by Kennedy/Jenks, March 1997.

#### Other Emerging Contaminants

NDMA and hexavalent chromium (chromium VI) are emerging contaminants that may possibly impact groundwater supplies. NDMA contamination of groundwater was initially believed to be the result of chemical contamination from liquid rocket fuels. It was detected in some California groundwaters at concentrations exceeding California's temporary action level of 0.02 µg/L. Further investigations have shown NDMA to be a disinfection by-product of some water and wastewater treatments. The formation mechanisms are unknown, but additional NDMA removal technologies may be required to avoid impacts on Southern California drinking water supplies. Current levels of NDMA in Metropolitan's system range from non-detect (reporting limit of 0.002 µg/L) to 0.007 µg/L. The presence of NDMA is not limited to Metropolitan waters and is believed to be relatively widespread.

Chromium VI is a possible contaminant in groundwater and surface water. Chromium is an inorganic chemical used in electroplating, leather tanning, wood treatment, pigments manufacture, and cooling tower treatment for corrosion control. It can enter drinking water sources through discharges from industries, leaching from hazardous waste sites, and erosion of natural deposits. The California Office of Health Hazard Assessment adopted a public health goal for total chromium at 2.5 µg/L. The MCL for total chromium is 0.05 mg/L, but is currently under review by the CDHS. The CDHS will likely add chromium VI to the list of unregulated chemicals for which monitoring will be required.

#### Watershed Management

Metropolitan has a significant interest in addressing water quality problems and

solutions on a regional or watershed basis due to the growing emphasis on drinking water source protection. Watershed management involves a comprehensive, fully integrated approach to watershed protection and restoration and water quality improvement. Metropolitan's interest in watershed management is to pursue source water quality improvement and water supply reliability objectives in the Bay-Delta system and the Colorado River basin. Additionally, water quality protection in watersheds, including those in Southern California, is essential for the success of groundwater conjunctive use programs. Metropolitan recently established legislative policy principles on watershed management. Metropolitan is also currently involved in watershed management planning efforts and is monitoring the impacts of recent decisions regarding urban storm water flows.

#### Legislative Policy Principles on Watershed Management

In January, 1995, Metropolitan's Board adopted legislative policy principles on watershed management addressing the following areas: the incorporation of source water quality improvement and supply reliability objectives into watershed management plans; the development of watershed management plans that recognized local authorities and conditions in the watershed; and participation as a stakeholder in watershed planning activities. Legislation considered by the State Legislature in 1999 and introduced in 2000 addressed funding mechanisms to support watershed management activities and the assessment of watershed funding needs. As a result, Metropolitan's Board adopted updated legislative policy principles on watershed management in April 2000. The adopted legislative policy principles provide direction to Metropolitan staff in the following areas:

#### *Funding for Watershed Management*

- Support public funding for watershed restoration and management programs that provide broad public benefits, including water quality, water supply reliability and environmental improvements. Public funding mechanisms include voter-approved State General Obligation Bonds and federal and state budget appropriations.
- Public agencies that administer watershed management funding programs and allocate public funds for specific watershed projects should: (1) develop well-defined criteria for the distribution of funds; (2) justify that funding levels represent actual needs; (3) provide oversight for the funding program; and (4) specify monitoring and reporting requirements for watershed project proponents receiving funding.
- Support watershed management funding methods that promote watershed responsibility and fairly allocate costs to those entities responsible for water quality degradation in the watershed.
- Watershed management programs funded by fees on water exporters or on residential, commercial and industrial users of water on a case by case basis. Such fees must meet the following criteria: (1) the purpose and use of the fee must be clearly identified; and (2) a determination must be made that there is a reasonable relationship between the fee and the benefit to be derived. These criteria are consistent with Government Code Section 66001 concerning fees for development projects.

#### *Watershed Management Plans*

- Support legislation that provides for the development of watershed management plans, in both the southern California

region and the Bay-Delta watershed, that are consistent with the following criteria:

- Watershed management plans should address all water resources management objectives for the watershed, including source water quality improvement, groundwater protection, water supply reliability, flood protection and ecosystem restoration objectives.
- To achieve water quality improvement objectives for surface waters and groundwater basins, watershed management plans should address all sources of pollutants within the watershed and consider the relative impact of each source when developing and implementing control measures.
- Watershed management plans should recognize local primacy in basin management and land-use planning, consider local conditions, needs and objectives, and encourage joint cooperation in watershed management activities.
- Watershed planning processes should have a public participation process that includes public drinking water suppliers as a stakeholder and facilitates cooperative working relationships among all watershed stakeholders.
- Watershed management plans should be consistent and coordinated with the authority of the State to manage allocation of water supplies within its jurisdiction.

#### *Participation in Watershed Planning Processes*

- Support Metropolitan's involvement as a stakeholder in watershed planning and management processes for imported sources of supply (i.e., the Bay-Delta watershed and the multi-state Colorado

River watershed), to work in cooperation with other watershed stakeholders, and ensure consideration of drinking water quality and water supply reliability objectives.

- Support Metropolitan's involvement as a stakeholder working cooperatively with the member agencies and others on watershed planning efforts for local water supplies and potential local water supplies, to ensure consideration of drinking water quality and water supply reliability objectives.

#### Recent Activities

##### *Regulations on Storm Water Flows*

Metropolitan monitors developments in the regulations regarding storm water flows including those set by the Los Angeles Regional Water Quality Control Board (LARWQCB). The LARWQCB adopted a Standard Urban Storm Water Mitigation Plan (SUSMP) for Los Angeles County and its cities.<sup>3</sup> The LARWQCB found that, "Storm water runoff will normally convey a disproportionate loading of pollutants in the initial period runoff generated during a storm event. Storm events generating up to 0.75 inches of precipitation, measured over a 24-hour period, constitute 85 percent of the total amount of runoff that can be expected during an average wet season."<sup>4</sup> The SUSMP does include related design standards for structural or treatment control Best Management Practices for mitigation of storm water runoff.

<sup>3</sup>Final Approved Standard Urban Storm Water Mitigation Plan for Los Angeles County and Cities in Los Angeles County, March 8, 2000

<sup>4</sup>State of California, California Regional Water Quality Control Board, Los Angeles Region, Resolution No. R-00-02, Approving the Standard Urban Water Mitigation Plan for Municipal Storm Water and Urban Runoff Management Programs in Los Angeles County, January 26, 2000.

#### *Water Augmentation Study*

Metropolitan has an interest in quality and quantity implications of the SUSMP and is currently participating in a Water Augmentation Study initiated by the Los Angeles and San Gabriel Rivers Watershed Council (Watershed Council.) The Watershed Council is a non-profit organization that brings together community groups, government agencies, businesses, and academia to solve problems in the watershed. The Watershed Council has initiated the study on how to both augment water quantity and improve water quality in the watershed. Metropolitan is part of the Memorandum of Understanding for the funding of Phase 1 of the Water Augmentation Study, along with other federal, state, and local agencies. Phase 1 of the study will focus on defining the quality of stormwater runoff and prioritizing the quality of the runoff. Later phases will define the quantity of water in the watershed that could be developed to augment local water resources, define watershed benefits of watershed activities (best management practices), and ensure there are no negative water quality impacts to the groundwater resources.

#### *Watershed Conference*

Metropolitan hosted a Watershed Decision Makers Dialogue Conference in November 2000 at its headquarters building. A unique aspect of the two-day conference was that it brought land use and water decision makers, elected officials, and top appointees together to discuss mutually beneficial solutions to some of the challenges in their respective areas. The conference featured legislative perspectives, statewide resource agency programs, success stories from both Northern and Southern California watersheds, and practical ways to meet the emerging stormwater pollution regulations. The goal of the conference was to discover areas of common interest and mutual opportunity for cost effective, multi-benefit solutions, while restoring and protecting our natural resources.



***APPENDIX A.1***  
***DEMAND FORECAST***

## A.1 DEMAND FORECAST

### Forecast Overview

Water demand in the Metropolitan service area has experienced several discernable trends in the past five years. Southern California emerged from a regional economic recession in the mid-1990s. Despite the robust economy, the sustained development of long-term conservation programs and increases in pricing have succeeded in suppressing growth in demands. Metropolitan projects that aggregate water demand will continue along this trend; per capita water demand will not return to its pre-drought highs, with conservation programs and water pricing offsetting water demand growth.

To forecast urban water demands, Metropolitan uses the MWD-MAIN Water Use Forecasting System. MWD-MAIN is a

model combining statistical and end-use methods that has been adapted to conditions in Southern California. The statistical portion of the model incorporates projections of demographic and economic variables from regional planning agencies (the Southern California Association of Governments, or SCAG, and the San Diego Association of Governments, or SANDAG) into statistically estimated water demand models to produce forecasts of water demand. The end-use portion of the model derives estimates of conservation by adding additional information on how that water is used – the end uses.

The MWD-MAIN system features a separate unique model for each sector. Table A.1-1 depicts these key relationships in the MWD-MAIN model. In the residential sector, the forecasts of water demand per dwelling unit

**Table A.1-1**  
**MWD-MAIN Relationships by Demand Sector**

Demand Sector	Dependent Variable	Key Explanatory Variables
Single Family Residential	Demand per household	Service area location Household size Weather conditions Household income Price and conservation
Multifamily Residential	Demand per household	Service area location Household size Weather Household income Price and conservation
Industrial Commercial, Institutional	Demand per employee	Employment by S.I.C grouping Price and conservation Service area location
System Losses/Other		Percentage of total use



are ultimately combined with the forecasts of dwelling units from the regional planning agencies to yield an estimate of total sector water demand. Similarly, in the nonresidential sector, water use per employee is combined with forecasts of employment to yield an estimate of total non-residential water demand.

In addition to accounting for future demographic trends, Metropolitan's water demand forecasts incorporate current and future water demand management (conservation) efforts. In 1991, Metropolitan signed a *Memorandum of Understanding Regarding Urban Water Conservation in California* (MOU). The MOU commits Metropolitan to implement a number of long-term water conservation measures referred to as Best Management Practices (BMPs). (A more detailed discussion of Metropolitan's efforts in implementing the BMPs is presented in Section III.1.)

--The MWDMAIN model embeds a detailed accounting of water conservation, distinguishing between:

- *Passive Conservation* – Water saved as a result of changes in water efficiency requirements for plumbing fixtures in plumbing codes. This form of conservation would occur without any water agency action.
- *Active Conservation* – Water saved directly as a result of conservation programs by water agencies (including implementation of Best Management Practices). This form of conservation is unlikely to occur without agency action.
- *Price-effect Conservation* – Water saved by retail customers attributable to the effect of changes in the real (inflation-adjusted) price of water. There may be

some overlap between this form of conservation and the previous two. For example, increased water prices might induce a consumer to take part in one of the active conservation programs run by the providing agency.

Metropolitan's demand projections account for the effects of the conservation BMPs, including projected changes in the price of water. The forecast is based on expected BMP participation, recognizing that some of the region's retail agencies are not BMP signatories and that some BMPs are not cost effective in Metropolitan's service area.

### ***Trends in Southern California***

#### **Population**

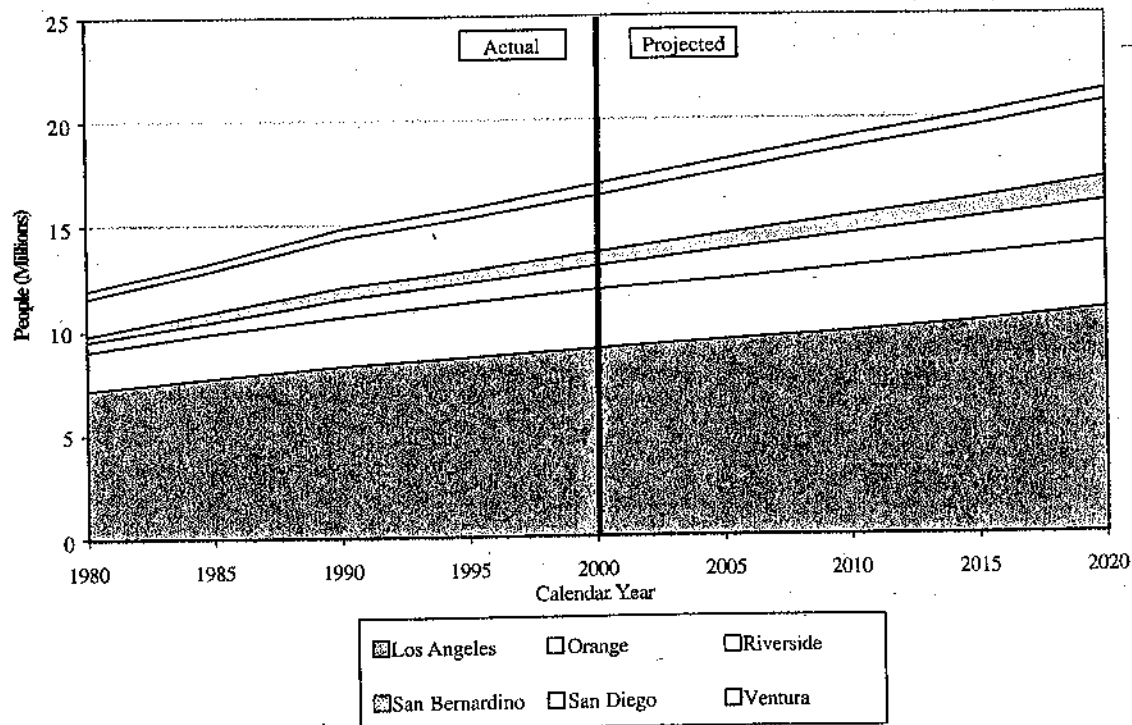
The population of Metropolitan's service area was approximately 15.8 million in 1995 and has grown to approximately 16.9 million in 2000. This represents an annual addition over this five-year period of about 211,000 people per year. The historic and projected population growth by county within Metropolitan's service is shown in Figure A.1-1 and Table A.1-2. The population in the entire service area is projected to be approximately 21.3 million by the year 2020, constituting an average annual increase of about 223,000 people per year.

#### **Industrial and Commercial**

Southern California accounts for a significant portion of the state's economy, accounting for approximately 54% of the state's total personal income. In 1999, total personal income in Southern California was estimated to be \$535 billion.<sup>1</sup>

<sup>1</sup>Center for Continuing Study of the California Economy, California County Projections, 2000 Edition

**Figure A.1-1  
Actual and Projected Population**



Employment growth will not occur at the same rate across the six counties (Table A.1-3). Over the 20-year period, 2000-2020, the greatest employment increases are expected to occur in Los Angeles County (with more than one million additional jobs expected). Relative to existing employment, Riverside and San Bernardino counties are expected to have the fastest rates of growth (104 and 91 percent), followed by Ventura and Orange counties (64 and 41 percent), and San Diego and Los Angeles counties (29 and 25 percent).

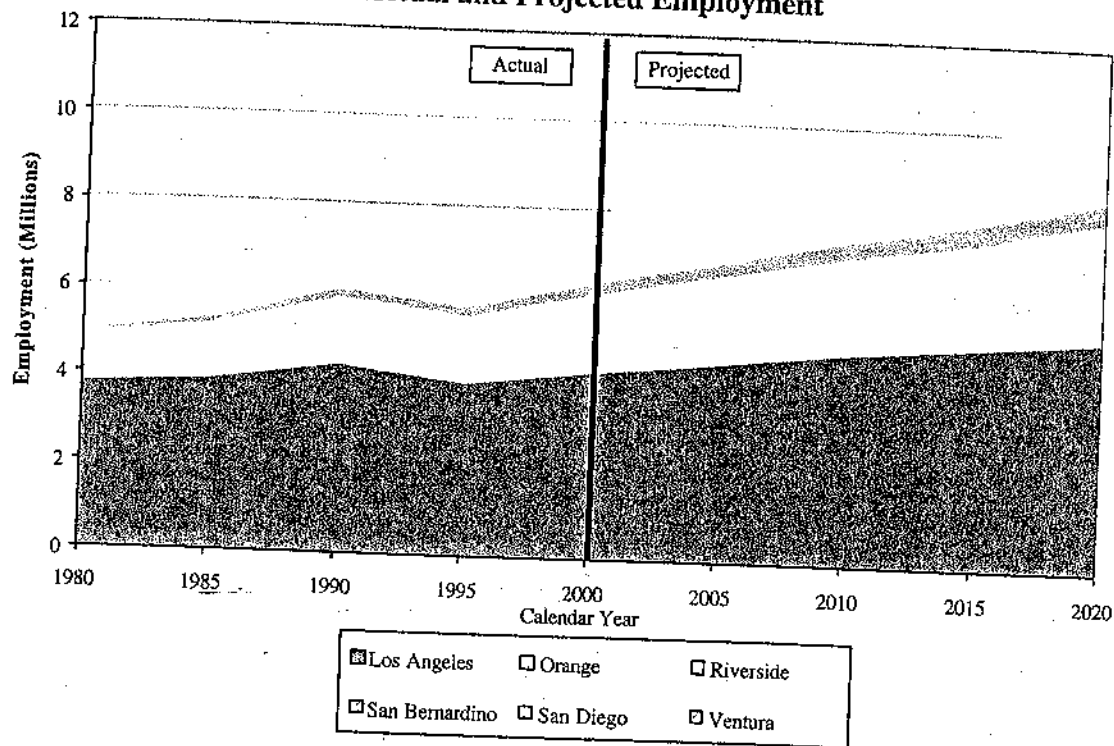
Table A.1-3 and Figure A.1-2 summarize the projections of commercial/institutional and industrial employment in Metropolitan's service area. The number of people employed is expected to increase from 7.8 million in 2000 to about 10.5 million in 2020. This increase of about 35 percent is greater than the projected population (26 percent) and housing

growth (30 percent), suggesting that a somewhat greater proportion of the population will be employed over time.

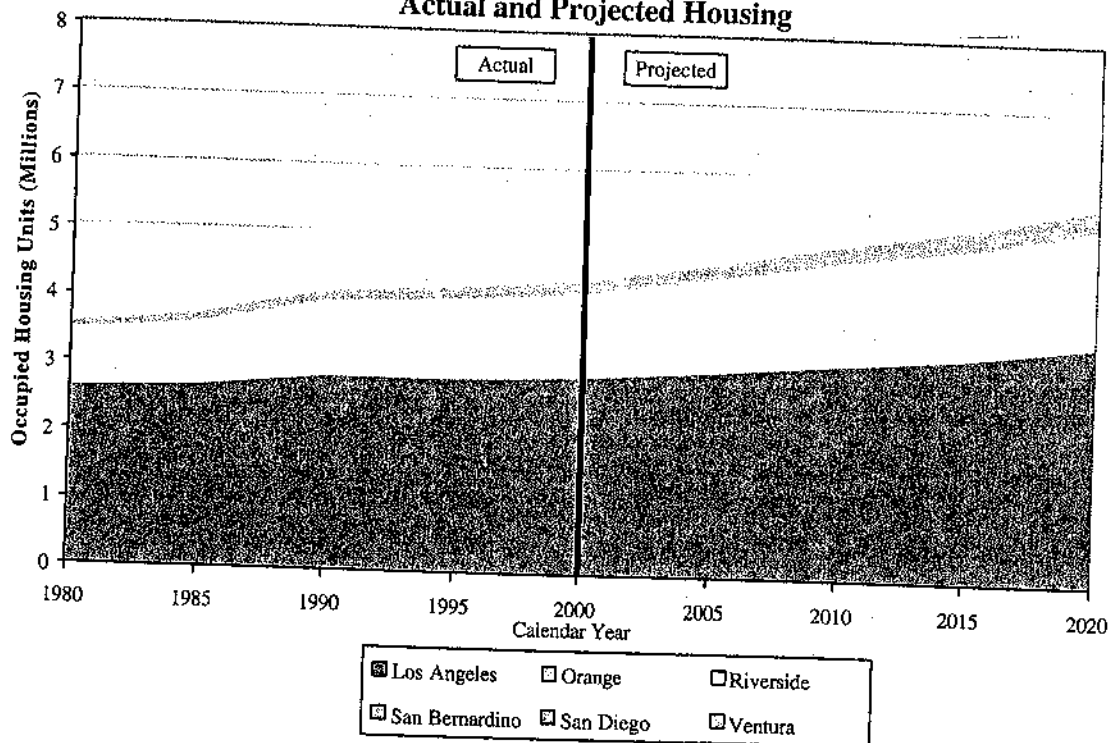
#### Residential Consumers

Regional planning agencies – SCAG and SANDAG – have forecast growth in residential housing in all geographic areas of the Metropolitan service area (Figure A.1-3 and Table A.1-4). The total occupied housing stock is expected to increase more than 30 percent from 2000 to 2020 (from 5.4 to 7.1 million housing units). Much of this growth is forecasted to occur in inland areas. No increase in the area served is expected at this time. Within the service area, the household occupancy size (household population divided by total occupied dwelling units) is forecasted to remain at around three persons per household.

**Figure A.1-2**  
**Actual and Projected Employment**



**Figure A.1-3**  
**Actual and Projected Housing**



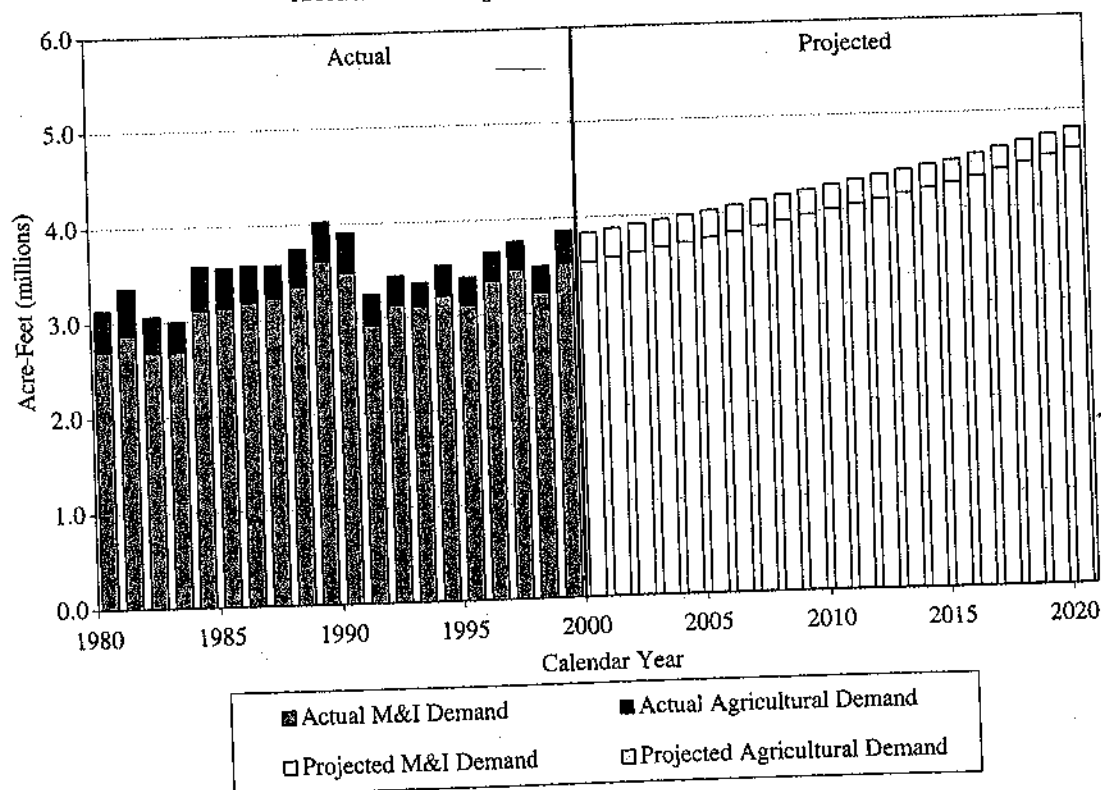
### Water Demands

Historical retail water demands in Metropolitan's service area have increased from 3.1 million acre-feet (af) in 1980 to 3.9 million af in 1990 (Figure A.1-4 and Table A.1-5). Due to the recession, wet weather, unprecedented conservation efforts, and lingering drought impacts, water use was lower for several years in the mid-nineties. Of the 3.5 million af used in 1998, 3.2 million af (91 percent) were used for municipal and industrial purposes (M&I), and 0.3 million af (9 percent) were used for agricultural purposes. The relative share of M&I water use to total water use has been increasing over time as agricultural water use has declined due to urbanization and market factors, including the price of water. Agricultural water use accounted for 14 percent in 1980, 11 percent in 1990, 9 percent in 1995, and 8.3 percent in 1997.

Total water use is projected to grow from a projected 3.8 million af in 2000 to 4.8 million af in 2020 (Table A.1-5). All water demand projections begin in the year 2000 and reflect demands under normal weather conditions. The water demand forecasts account for water savings resulting from plumbing codes, price effects, and actual and projected implementation of Best Management Practices. Per capita water demand is forecast to remain relatively constant over the 20-year forecast horizon (Table A.1-13).

*By County* – Total retail water demand is not expected to grow uniformly across counties. Following the pattern of the demographic projections, the greatest increase in urban water demands is expected to occur in Los Angeles, Riverside, and San Diego counties. The largest absolute increase in water demand is expected

Figure A.1-4  
Actual and Projected Retail Water Demand



to occur in Los Angeles County, an increase of 380,000 af per year between 2000 and 2020. Relative to current water demands, demands in Riverside County are expected to increase at the fastest rate (51 percent between 2000 and 2020). The counties with the smallest percent increases in population are also projected to experience the smallest percent increase in water demand (Los Angeles and Orange).

*By Sector* – Water use can also be broken down by sector. Between 2000 and 2020, single-family residential water use is expected to increase by 27 percent (Table A.1-8), while multifamily water use is expected to increase by 43 percent (Table A.1-9). Nonresidential water use between 2000 and 2020 is expected to increase by 27 percent (Table A.1-10). Water use projections for the nonresidential sector generally follow the employment projections shown in Table A.1-3. There is an additional sector needed to account for system losses and any other retail demand; these residual demands are identified in Table A.1-11.

#### Residential Water Use

Although single-family homes account for about 55 percent of the total occupied housing stock, they account for about 70 percent of total residential water demands. This variation occurs because single-family households tend to use more water than households in a multifamily structure (such as apartment buildings) on a per housing-unit basis. Single-family households tend to have more persons living in the household; they are likely to have more water-using appliances and fixtures; and they tend to have more landscaping per home.

#### Nonresidential Water Use

Nonresidential water use represents about 25 percent of the total M&I demands in Metropolitan's service area. The nonresidential

sector represents water that is used by businesses, services, government, institutions (such as hospitals and schools), and industrial (or manufacturing) establishments. Within the commercial/institutional category, the top water users include schools, hospitals, hotels, amusement parks, colleges, laundries, and restaurants. In Southern California, the major industrial users include electronics, aircraft, petroleum refining, beverages, food processing, and other industries that use water as a major component of the manufacturing process.

#### Agricultural Water Use

Agricultural water use currently constitutes about 8 percent of total regional water demand in Metropolitan's service area. Metropolitan has historically provided water supplies to meet 30 to 50 percent of total agricultural water demand. Remaining agricultural water demands are met by local water supplies. Table A.1-7 depicts historical and projected agricultural water demands by county.

#### MWD Sales

Historical and projected MWD sales by category of sale are shown in Table A.1-15. Categories of sales in the future may change due to the strategic planning process and the related rate restructuring.

Table A.1-2 Estimated and Projected Population in Metropolitan's Service Area

County	Estimated				Projected				Percent Change 2000-2020
	1980	1985	1990	1995	2000	2005	2010	2015	2020
Los Angeles County	7,097,600	7,720,200	8,251,900	8,646,400	9,045,400	9,400,000	9,754,700	10,233,700	10,778,500
Orange County	1,918,400	2,142,500	2,397,000	2,595,900	2,804,100	2,954,000	3,103,800	3,164,000	3,242,700
Riverside County	458,000	592,500	821,400	962,500	1,095,400	1,356,600	1,617,900	1,805,000	2,000,300
San Bernardino County	339,700	422,500	548,200	613,800	667,000	764,800	862,600	955,000	1,045,900
San Diego County	1,751,800	1,969,600	2,348,000	2,522,000	2,761,000	3,015,400	3,269,700	3,457,600	3,667,600
Ventura County	334,500	397,400	448,000	478,000	502,800	517,200	531,500	563,700	603,400
<b>Metropolitan Total</b>	<b>11,900,000</b>	<b>13,244,700</b>	<b>14,814,500</b>	<b>15,818,600</b>	<b>16,875,700</b>	<b>18,008,000</b>	<b>19,140,200</b>	<b>20,179,000</b>	<b>21,338,400</b>

Estimated: Based on DOF January Estimates and SCAG/SANDAG information.

Projected: Based on SCAG RTP (1997) and SANDAG 2020 (1998) projections.

Table A.1-3 Estimated and Projected Urban (M&amp;I) Employment in Metropolitan's Service Area

County	Estimated				Projected				Percent Change 2000-2020
	1980	1985	1990	1995	2000	2005	2010	2015	2020
Los Angeles County	3,752,100	3,902,100	4,298,600	3,922,500	4,229,800	4,520,500	4,811,500	5,030,000	5,267,000
Orange County	910,500	1,068,000	1,287,000	1,273,500	1,483,500	1,588,700	1,693,700	1,857,400	2,089,300
Riverside County	137,000	167,400	236,000	260,100	325,500	414,800	504,100	576,400	663,700
San Bernardino County	107,400	131,800	190,000	221,400	265,300	324,900	384,500	442,200	506,900
San Diego County	767,100	890,600	1,097,400	1,117,700	1,274,100	1,377,100	1,480,100	1,548,300	1,643,300
Ventura County	95,400	119,600	158,000	165,300	186,000	214,200	242,300	272,300	305,100
<b>Metropolitan Total</b>	<b>5,769,500</b>	<b>6,279,500</b>	<b>7,267,000</b>	<b>6,960,500</b>	<b>7,764,200</b>	<b>8,440,200</b>	<b>9,116,200</b>	<b>9,726,600</b>	<b>10,475,300</b>

Estimated: Based on EDD Data and SCAG/SANDAG information.

Projected: Based on SCAG RTP (1997) and SANDAG 2020 (1998) projections.

**Table A.1-4 Estimated and Projected Occupied Housing in Metropolitan's Service Area**

County	Estimated					Projected				Percent Change 2000-2020
	1980	1985	1990	1995	2000	2005	2010	2015	2020	
Los Angeles County	2,607,200	2,670,100	2,821,500	2,845,600	2,882,500	3,014,200	3,145,900	3,293,300	3,525,700	22.3%
Orange County	685,900	736,000	823,200	864,500	910,200	961,200	1,012,300	1,063,700	1,101,500	21.0%
Riverside County	166,000	196,400	278,300	316,300	348,800	434,400	519,900	573,500	644,100	84.7%
San Bernardino County	111,400	129,700	174,500	186,900	198,200	230,800	263,300	293,400	326,000	64.5%
San Diego County	660,700	710,700	849,300	896,500	944,700	1,035,600	1,126,400	1,197,400	1,275,200	35.0%
Ventura County	105,200	121,000	141,200	148,500	155,400	165,200	175,000	187,800	204,000	31.3%
<b>Metropolitan Total</b>	<b>4,336,400</b>	<b>4,563,900</b>	<b>5,088,000</b>	<b>5,258,300</b>	<b>5,439,800</b>	<b>5,841,400</b>	<b>6,242,800</b>	<b>6,609,100</b>	<b>7,076,500</b>	<b>30.1%</b>

Estimated: Based on DOF January Estimates and SCAG/SANDAG information.

Projected: Based on SCAG RTP (1997) and SANDAG 2020 (1998) projections.

**Table A.1-5 Total Retail Water Demand in Metropolitan's Service Area (Acre-Feet)**

County	Reported					Projected				Percent Change 2000-2020
	1980	1985	1990	1995	2000	2005	2010	2015	2020	
Los Angeles County	1,527,700	1,707,500	1,743,500	1,593,200	1,692,300	1,756,900	1,838,600	1,938,200	2,070,900	22.4%
Orange County	520,200	593,900	651,400	587,900	665,600	685,100	709,200	737,700	774,200	16.3%
Riverside County	348,000	375,600	480,200	403,700	488,500	540,100	593,600	629,500	679,500	39.1%
San Bernardino County	169,700	188,000	209,700	184,300	214,100	239,400	265,900	292,900	322,500	50.6%
San Diego County	476,400	579,600	678,400	522,000	637,300	669,600	715,600	748,300	790,800	24.1%
Ventura County	96,500	115,800	142,000	110,300	132,900	138,500	145,000	154,800	167,300	25.9%
<b>Metropolitan Total</b>	<b>3,138,500</b>	<b>3,560,400</b>	<b>3,905,200</b>	<b>3,401,400</b>	<b>3,830,700</b>	<b>4,029,600</b>	<b>4,267,900</b>	<b>4,501,400</b>	<b>4,805,200</b>	<b>25.4%</b>

Note: Includes total Agricultural and M&I use.

**Table A.1-6 Retail Municipal and Industrial (M&I) Water Demand in Metropolitan's Service Area (Acre-Feet)**

County	Reported				Projected					Percent Change 2000-2020
	1980	1985	1990	1995	2000	2005	2010	2015	2020	
Los Angeles County	1,521,300	1,702,300	1,739,800	1,583,800	1,690,600	1,755,400	1,837,300	1,937,000	2,069,900	22.4%
Orange County	481,100	549,400	625,200	571,400	647,900	669,200	695,200	725,600	763,800	17.9%
Riverside County	141,000	173,600	279,400	243,500	313,000	381,200	451,300	503,800	569,300	81.9%
San Bernardino County	123,600	150,300	172,500	152,100	186,300	214,400	243,700	273,500	305,800	64.1%
San Diego County	364,600	469,200	549,000	463,300	565,400	598,800	645,800	679,600	723,100	27.9%
Ventura County	77,100	93,800	114,500	96,000	119,700	126,300	133,800	144,600	158,000	32.0%
Metropolitan Total	2,708,700	3,138,600	3,480,400	3,110,100	3,522,900	3,745,300	4,007,100	4,264,100	4,589,900	30.3%

Reported: Metropolitan Estimates.

Projected: 2000 Sales Forecast - Retail M&I Projections.

**Table A.1-7 Retail Agricultural Water Demand in Metropolitan's Service Area (Acre-Feet)**

County	Reported					Projected					Percent Change 2000-2020
	1980	1985	1990	1995	2000	2005	2010	2015	2020		
Los Angeles County	6,300	5,300	3,700	9,400	1,700	1,500	1,300	1,200	1,000	-41.2%	
Orange County	39,000	44,500	26,300	16,500	17,700	15,900	14,000	12,100	10,400	-41.2%	
Riverside County	207,000	202,000	200,800	160,200	175,500	158,900	142,300	125,700	110,200	-37.2%	
San Bernardino County	46,100	37,700	37,200	32,200	27,800	25,000	22,200	19,400	16,700	-39.9%	
San Diego County	111,800	110,400	129,400	58,700	71,900	70,800	69,800	68,700	67,700	-5.8%	
Ventura County	19,400	22,000	27,400	14,300	13,200	12,200	11,200	10,200	9,300	-29.5%	
Metropolitan Total	429,600	421,900	424,800	291,300	307,800	284,300	260,800	237,300	215,300	-30.1%	

Reported: Metropolitan Estimates.

Projected: 2000 Sales Forecast - Retail Agricultural Projections.



Table A.1-8 Single-Family Retail Demands in Metropolitan's Service Area (Acre-Feet)

Member Agency	Model Estimates *		Projected				Percent Change 2000-2020
	1990	FY97	2000	2005	2010	2015	2020
Los Angeles County	712,900	713,900	693,800	710,000	726,100	753,300	793,400
Orange County	290,000	305,800	309,900	319,500	331,500	341,100	353,500
Riverside County	149,900	176,700	182,500	223,000	265,300	294,400	329,800
San Bernardino County	90,700	102,700	99,700	112,100	124,800	137,300	149,200
San Diego County	252,300	271,500	282,100	304,400	324,800	342,700	364,700
Ventura County	66,400	72,200	66,700	69,100	72,000	76,900	83,300
<b>Metropolitan Total</b>	<b>1,562,200</b>	<b>1,642,800</b>	<b>1,634,700</b>	<b>1,738,100</b>	<b>1,844,500</b>	<b>1,945,700</b>	<b>2,073,900</b>
							<b>26.9%</b>

\* Values for 1990 and FY97 are model estimates, and may not agree with reported retail demands.

Table A.1-9 Multifamily Retail Demands in Metropolitan's Service Area (Acre-Feet)

Member Agency	Model Estimates *		Projected				Percent Change 2000-2020
	1990	FY97	2000	2005	2010	2015	2020
Los Angeles County	391,800	377,100	384,100	400,600	429,200	467,000	519,100
Orange County	117,700	118,600	123,400	130,300	138,800	147,800	157,500
Riverside County	39,100	42,400	46,200	57,700	70,300	80,200	92,300
San Bernardino County	22,400	24,200	25,800	30,700	36,500	42,100	49,700
San Diego County	103,500	105,400	108,700	118,100	133,800	148,800	165,700
Ventura County	13,700	14,500	15,000	15,700	16,500	18,000	19,900
<b>Metropolitan Total</b>	<b>688,200</b>	<b>682,200</b>	<b>703,200</b>	<b>753,100</b>	<b>825,100</b>	<b>903,900</b>	<b>1,004,200</b>
							<b>42.8%</b>

\* Values for 1990 and FY97 are model estimates, and may not agree with reported retail demands.

Table A.1-10 Non-Residential Retail Demands in Metropolitan's Service Area (Acre-Feet)

Member Agency	Model Estimates *		Projected				Percent Change 2000-2020
	1990	FY97	2000	2005	2010	2015	2020
Los Angeles County	493,600	450,500	461,200	487,700	517,700	543,900	573,100
Orange County	162,900	164,300	164,000	167,100	170,700	180,100	193,200
Riverside County	41,600	51,000	56,400	66,800	76,100	85,100	97,400
San Bernardino County	32,500	34,200	37,900	45,200	52,500	60,400	69,300
San Diego County	127,700	136,100	130,500	129,700	136,800	135,100	136,300
Ventura County	25,200	28,500	28,600	31,600	34,900	38,400	42,500
<b>Metropolitan Total</b>	<b>883,500</b>	<b>864,600</b>	<b>878,600</b>	<b>928,100</b>	<b>988,700</b>	<b>1,043,000</b>	<b>1,111,800</b>
							<b>26.5%</b>

\* Values for 1990 and FY97 are model estimates, and may not agree with reported retail demands.

Table A.1-11 System Losses and Other Uses in Metropolitan's Service Area (Acre-Feet)

Member Agency	Model Estimates *		Projected				Percent Change 2000-2020
	1990	FY97	2000	2005	2010	2015	2020
Los Angeles County	156,200	151,200	151,400	157,100	164,300	172,900	184,300
Orange County	48,300	49,800	50,500	52,200	54,200	56,600	59,600
Riverside County	22,700	26,400	27,800	33,700	39,700	44,200	49,800
San Bernardino County	20,400	22,600	22,900	26,400	30,000	33,600	37,600
San Diego County	40,900	43,400	44,100	46,700	50,400	53,000	56,400
Ventura County	8,900	9,700	9,300	9,900	10,400	11,300	12,300
<b>Metropolitan Total</b>	<b>297,400</b>	<b>303,100</b>	<b>306,000</b>	<b>326,000</b>	<b>349,000</b>	<b>371,600</b>	<b>400,000</b>
							<b>30.7%</b>

\* Values for 1990 and FY97 are model estimates, and may not agree with reported retail demands.



Table A.1-14 Projected Municipal and Industrial Demands by Sector (Acre-Feet)

Sector	Model Estimates *		Projected				Percent Change 2000-2020
	1990	FY97	2000	2005	2010	2015	2020
Single-Family	1,562,200	1,642,600	1,634,700	1,738,100	1,844,500	1,945,700	2,073,900
Multifamily	688,300	682,100	703,200	753,100	825,100	903,900	1,004,200
Non-Residential	883,400	864,500	878,600	928,100	988,700	1,043,000	1,111,800
System Losses/Other	297,200	303,000	306,000	326,000	349,000	371,600	400,000
<b>MWD Total</b>	<b>3,431,100</b>	<b>3,492,200</b>	<b>3,522,500</b>	<b>3,745,300</b>	<b>4,007,300</b>	<b>4,264,200</b>	<b>4,589,900</b>
							<b>30.3%</b>
Single-Family	45.5%	47.0%	46.4%	46.4%	46.0%	45.6%	45.2%
Multifamily	20.1%	19.5%	20.0%	20.1%	20.6%	21.2%	21.9%
Non-Residential	25.7%	24.8%	24.9%	24.8%	24.7%	24.5%	24.2%
System Losses/Other	8.7%	8.7%	8.7%	8.7%	8.7%	8.7%	8.7%
<b>MWD Total</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>

Table A.1-15 Actual and Projected Demands on Metropolitan

Program	Actual				Estimate 2000	2000 Sales Forecast - Projected			
	1980	1985	1990	1995		2005	2010	2015	2020
Agricultural	179,963	176,810	205,653	89,551	125,687	91,020	80,977	71,146	61,886
Full Service	947,856	1,060,689	1,605,061	1,195,558	1,705,008	1,618,972	1,689,550	1,827,681	2,057,114
Long Term	-	-	-	-	265,065	134,213	126,047	120,286	118,779
Seasonal Shift	-	-	-	-	129,034	119,409	119,771	120,066	120,221
Seasonal Unclassified	174,892	422,350	404,568	94,464	-	-	-	-	-
Other *	-	-	400,695	50,000	37,813	-	-	-	-
<b>MWD Total</b>	<b>1,302,711</b>	<b>1,659,849</b>	<b>2,615,978</b>	<b>1,429,573</b>	<b>2,262,607</b>	<b>1,963,614</b>	<b>2,016,345</b>	<b>2,139,179</b>	<b>2,358,001</b>

\* Includes Bank, Cooperative Storage, Cyclic Storage, Demonstration Storage, Local Storage, Reimbursable Construction, Pre-deliveries and/or Wheeling

Notes: Sales forecast does not include SDCWA/IID Transfer and Eastern Seepage Water

1980 and 1995 are wet years

1985, 1990, and 2000 are dry years